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ABSTRACT

The study describes a curriculum developed to train teachers to teach data processing at the high school, technical/vocational institute, or community college level, and to develop courses for undergraduate and graduate students in the fields of business administration, education, psychology, sociology, and science. A 20-page introduction deals with the setting, limitations, and organization of the study. A review of the related literature surveys general studies of data processing curricula and specific descriptions of related four-year degree programs in North Carolina. The curriculum description presents and discusses eight courses: principles of automatic data processing; FORTRAN programing; electronic data processing 1 and 2; COBOL programing; systems design and analysis; application of digital computers as an instrument for research; and automatic data processing for teachers. Two appendixes comprising 50 pages include data processing courses and catalog descriptions from sample four-year institutions, and detailed course outlines covering objectives, catalog descriptions, level, prerequisites, credit and content for the eight courses. (JR)

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ABSTRACT

Title: A CURRICULUM STUDY IN DATA PROCESSING

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It was the purpose of this study to develop a curriculum to train teachers to teach the various facets of data processing on the high school, vocational-technical institute, or community college level and to develop courses which meet the needs of undergraduate and graduate students in the fields of business administration, education, psychology, sociology, and the sciences at Appalachian State University.

The curriculum was developed based upon a review of the related literature and a survey of other four-year degree programs in the state. The objectives and needs of the university as set forth by the Dean of the College of Business, the Department Chairman, and an ad hoc computer science comittee were other bases for this study.

Based on the findings, a curriculum was devised comprised of eight courses in the field of data processing:

Course I - Principles of Automatic Data Processing - history, theory, principles, technical aspects of automatic data processing, and acquisition of skill in wiring basic unit record machines; introduction to electronic data processing, systems analysis, and flow charts.

Course II - FORTRAN Programming - coding, compiling, testing, and debugging simple FORTRAN IV problems to be run on the University Computer Center's equipment.

Course III - Electronic Data Processing I - introduction to major concepts and characteristics of data processing.

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Course IV - Electronic Data Processing II - introduction to basic assembler language covering instructions and capabilities of the language in detail.

Course V - COBOL Programming - develop ability to solve business related problems with the use of digital computer techniques.

Course VI - Systems Design - development of systems solutions that include documentation of input, output, data flow, and general description of runs and logic.

Course VII - Application of Digital Computers as an Instrument for Research - formulation of numerical problems in FORTRAN IV language for solution on digital computers related to business, science, education, and the behavioral sciences.

Course VIII - Automatic Data Processing for Business Teachers - emphasizes teaching problems and procedures related to wiring and operation of unit record equipment (card design, key punching, sorting, collating, and preparation of reports).

The data processing curriculum presented in this study includes two courses on the undergraduate level, five on the five year (graduate) level, and one on the six year (post-graduate) level. The curriculum as stated does not lead to a major in computer science as one has not been approved for the institution at this time; however, the course of study would serve as a base on which to develop a more comprehensive curriculum in the future.

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A CURRICULUM STUDY IN DATA PROCESSING

CURRICULUM DEVELOPMENT

by

Emily D. Gloster

Appalachian State University

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Dr. Leland Cooper

A PRACTICUM PRESENTED TO NOVA UNIVERSITY
IN PARTIAL FULFILLMENT OF THE REQUIREMENTS OF THE
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CHAPTER I

INTRODUCTION

I. BACKGROUND

Much material has been written in the past two decades about data processing, "magic brains," and a second Industrial Revolution. Many people fear automation because of its impact on the business environment and the mysterious terminology used by data processing personnel. However, "in its simplest definition, data processing is nothing but the handling of information. Automation is simply the use of mechanical devices to acomplish a job (Wood and Espegren, 1964, p.15)."

Data processing has been going on ever since "the first caveman learned to count on his stubby fingers (Wood and Espegren, 1964, p.15)."

Merchants on the Nile River dictated business transactions to their scribes who wrote the information on clay tablets with sharpened sticks. The invention of paper by the Egyptians accelerated the evolution of data processing; and in Italy 400 years ago, the double-entry system of bookkeeping was created which gave rise to modern-day accounting systems.

It was not until the 1940's, however, that "automation" in its true sense emerged. The Mark I, designed by

Professor Howard Aiken of Harvard University and built with the assistance of the International Business Machines Corporation in 1944, was the first successful working modern-day computer. The ENIAC was built and completed at the University of Pennsylvania in 1946. These early vacuum-tube computers were primarily designed and built by mathematicians and statisticians for their use in solving complicated mathematical formulas and equations.

The use of the computer has spread today into practically all phases of man's work. For example, in the area of business, the computer is used for inventory control, personnel records, and as an aid in management decisions to mention only a few. In medicine, the computer is being used to aid the dianostician, to monitor the vital signs of patients, and to assist in further medical research. In education, the computer is being used for pupil population projections, school scheduling, pupil personnel records, and in administrative decision making. The computer is also being used as a research tool in the areas of agriculture, psychology, sociology, and economics.

II. STATEMENT OF THE PROBLEM

The wide spread use of the computer has placed a responsibility on education to supply teachers, instructors, and professors who can teach and train students in the area

of data processing and to develop courses which will meet the students' needs and objectives.

It was the purpose of this study to:

1. develop a curriculum to train teachers to teach the various facets of data processing on the high school, vocational-technical institute, or community college level.

2. develop courses which meet the needs of undergraduate and graduate students in the fields of business administration, education, psychology, sociology, and the sciences at Appalachian State University, Boone, North Carolina.

III. IMPORTANCE OF THE STUDY

General

With the inevitable impact of data processing on office occupations alone, there is no question that educational institutions must realize their responsibility and challenge to prepare young people to compete for jobs.

Dr. E. Kendrick Bangs found in a national survey conducted in 1968 that about 19 per cent of the high schools were offering work in data processing or were planning to offer it. He found that schools are not meeting the needs in training personnel for job opportunities in data processing and that much more effort is needed to inaugurate curriculums in data processing and

to update the programs currently in existence (Bangs and Hillestad, 1968).

"Part of this confusion is caused by the fact that data processing is far more than 'just another course' to be squeezed into an already crowded curriculum (Bangs and Hillestad, 1968, pp. 12, 20)." High schools are perplexed with a dual responsibility: to the college-bound student who must meet academic requirements, and to the vocationally oriented student who must be prepared to compete in the new technological business environment.

Today, organizations are confronted with keen competition in the recruitment and retention of electronic data processing personnel. Dick H. Brandon (1966), of Brandon Applied Systems, Incorporated, stated that

> . . . because the [electronic data processing] field is growing, because there is a shortage of qualified people to man data processing installations, and because employers want those they want now, there is a real scramble for available talent [p.24]. . . .

Brandon (1966) contended that by 1970 both the quantity of operational electronic computers and the related data processing personnel requirements would increase by nearly 100 per cent.

Fred R. Raach (1966), Vice President and General Manager of the Data Processing Division of the

UNIVAC Division of Sperry Rand Corporation, related different employment needs when he state that the

> . . . requirements for manpower in 1970 are estimated to be three times the 150,000 analysts, programmers, and operating personnel in data processing today. . . . Despite the saving in manpower through technological changes eliminating some routine programming, the shortage in needs for programmers is expected to be acute over the next few years (p. 24).

Addressing the American Management Association, David B. Hertz (1966), a director of the McKinsey and Company management consultant firm, predicted that the 1970 deficit of computer personnel probably would reach the "famine" stage. As a result, ". . . the competition for talented people is going to be fierce (p. 6) . . ."

Background of Appalachian State University

The first men who came to the mountain frontier of Northwestern North Carolina found the going rough. A diary kept during the first known expedition into the area stated: "Part of the way we had to crawl on hands and feet; sometimes we had to take the baggage and saddles off the horses and drag them up the mountain, for the horses were in danger of falling backwards--as we had once an experience and sometimes we had to pull the horses up while they trembled and quivered like leaves."

When the first explorers reached the summit of the Blue Ridge Mountains, where a twig placed in a certain bubbling, cold, clear stream would drift either toward the Atlantic or the Mississippi, the explorers stood and marveled at the "hundreds of mountain peaks all around," which presented a "spectacle like ocean waves in a storm."

The area was first settled by English-speaking hunters. The first dwelling in Boone was a hunting cabin of a man named Benjamin Howard. That goes back to 1769. The cabin stood on what is now Appalachian State University. Daniel Boone used the cabin as a base for some eight years before he finally crossed the "great Appalachian barrier" and pushed on westward in Tennessee and Kentucky.

Benjamin Howard sided with the British during the Revolution, and he hid during the Revolutionary times from the patriots on a high knob above what was to become Boone (the knob became Howard's Knob). Howard later made peace with the patriots. The settlers who came after the Revolution were English, Scotch-Irish, and German. As the frontier moved forever westward, many crossed over the mountains.

Some stayed. They kept the proud, resourceful, rugged ways needed to survive in the beautiful, yet often hostile environment. The area was known as "the Lost Provinces," and for good reason. None but

the very determined could make it up where the high meadows lay against the sky. The railroad came in 1899 and truly good roads were not built until the 1940's.

For a long time in the area, formal education was carried out, weather permitting, after the fall crops were in until it was time to plow. Education was, at best, minimal. In 1899, a two-story frame structure was built in Boone, a town of 200 persons. The people of the local community contributed labor, materials and $1,100 to start a school--known as Watauga Academy. It offered instruction in grades one through 11 and in teacher training. Three courses were offered: Common School, Academic, and Two Years' Collegiate.

An institute always was held during the summer for teachers. Pupils received instruction on how to teach, thus making their work more enjoyable to them and more beneficial to the students, and they would be taught and coached in the very subjects upon which they would have to take an examination to renew their certificates or to raise them to the highest grade--The First Grade Certificate.

Watauga Academy grew steadily. In the winter of 1902 more than 100 pupils were enrolled, and 90 per cent of those were grown people.

Despite all the progress made, Watauga Academy "rested upon a precarious and almost starvation financial

foundation." The founders of the academy, the Dougherty brothers, D. D. and B. B., realized that without adequate financial support the academy would never be able to train enough teachers needed in the area. They turned to the state for help.

On a cold January morning in 1903, with a temperature of eight degrees, B. B. Dougherty started out for Lenoir on the family horse, and then continued by train for the capital city of Raleigh. In his pocket he carried a bill proposing a state institution for Northwestern North Carolina.

Dougherty encountered initial opposition for his proposal. The plight of the extreme northwestern edge of the state was not appreciated by some of the leaders of the day. Undaunted, Dougherty sought an appeal before Governor Charles B. Aycock, known as "the Education Governor." In the privacy of the Governor's office, Dougherty pointed out that the "Education Governor" could ill afford to oppose a bill that promised so much for the teacher. He reminded the Governor that he had boasted the building of a new schoolhouse every time the sun set since being elected and that certainly there was no need for a schoolhouse without a place to train a teacher.

Aycock pledged his support, and Dougherty appeared before the House Committee on Education. Dougherty

told the committee that the legislature had helped other sections of the state and it should help Northwestern North Carolina. He asked for only small appropriations, as the local people were willing to match state funds dollar-for-dollar.

Among the reasons given why teachers in Northwestern North Carolina could not attend the schools already established, Dougherty said, was that the salary of the teachers in the mountains was too low to allow them to attend a school where expenses were high; mountain people could not endure a summer in the heat of the flatlands; and the university professor would take little interest in the unsophisticated country teacher.

The bill was introduced into the House by the Honorable W. C. Newland of Lenoir. Joining with Newland was the Honorable R. A. Doughton who brought with him the prestige of his unexcelled reputation for wise statesmanship. Support also was given by senators from Cleveland, Franklin, and McDowell counties. The enabling bill passed by one vote more than needed for the two-thirds majority. Just before the measure came up, however, Mr. Newland suddenly notified two senators that they had other pressing "engagements." How they would have voted had they been present is not recorded.

In chartering a training school for teachers, the state pledged $2,000 annually for maintenance and $1,500

to be appropriated for buildings when a like amount was paid by private contributions. Tuition was to be free to those who pledged themselves to teach in the public schools of the state for two years.

The Doughertys won a major political and educational victory for the mountain region when, by a one-vote margin, the 1903 General Assembly created Appalachian Training School. Its just-appointed trustees met in Blowing Rock three months after the vote and heard representatives of several mountain counties and towns who spoke in behalf of locating the institution in their area. According to the minutes of the board, Boone offered the facilities of the academy as a home for the state school, and it was declared to be Appalachian's permanent location.

The board elected B. B. Dougherty as superintendent of the school, and his brother was named principal. They served under those titles and guided the school as it grew with the state system until 1921 when Superintendent Dougherty was named President, and Principal Dougherty was named Treasurer and Business Manager.

The Assembly changed the name of the institution to Appalachian State Normal School in 1925. In 1929 it became Appalachian State Teachers College. The enabling act which changed the name of the institution also authorized the conferring of college degrees.

Modest graduate programs began at the college in 1943, and in 1949 Appalachian's graduate school was sanctioned by the American Association of Colleges for Teacher Education.

It was not until 1957 that legislation was enacted to give Appalachian permission to depart from its single-purpose role as a teacher-training institution. In 1965 the institution activated programs that led to nonteaching degrees.

The regional universities shall provide undergraduate and graduate instruction in the liberal arts, fine arts, and sciences, and in the learned professions, including teaching, these being defined as those professions which rest upon advanced knowledge in the liberal arts and sciences, pure and applied. The regional universities shall provide other undergraduate and graduate programs of instruction as are deemed necessary to meet the needs of their constituencies and of the State. Regional universities insofar as possible shall extend their educational activities to all persons of the State who are unable to avail themselves of their advantages as resident students by means of extension courses, by lectures, and by such other means and methods as may seem to the boards of trustees and administrative officers as most effective.

In 1971, the structure of higher education in North Carolina was consolidated into a 16-member University of North Carolina system, efforts for which Appalachian supported.

The University of North Carolina was charted in 1789 and opened its doors to students in 1795. It has been governed by a Board of Trustees chosen by the legislature and presided over by the Governor. During the period 1917-1972, the Board consisted of 100 elected members and varying number of ex officio members.

By act of the General Assembly of 1931, without change of name, it was merged with The North Carolina College for Women at Greensboro and The North Carolina College of Agriculture and Engineering at Raleigh to form a multicampus institution designated The University of North Carolina.

In 1963 the General Assembly changed the name of the campus at Chapel Hill to The University of North Carolina at Chapel Hill and that at Greensboro to The University of North Carolina at Greensboro and, in 1965, the name of the campus at Raleigh to North Carolina State University at Raleigh.

Charlotte College was added as The University of North Carolina at Charlotte in 1965, and, in 1969, Asheville-Biltmore College and Wilmington College

became The University of North Carolina at Asheville and The University of North Carolina at Wilmington, respectively.

A revision of the North Carolina State Constitution adopted in November, 1970 included the following: "The General Assembly shall maintain a public system of higher education, comprising The University of North Carolina and such other institutions of higher education as the General Assembly may deem wise. The General Assembly shall provide for the selection of trustees of The University North Carolina. . ." In slightly different language, this provision has been in the Constitution since 1868.

On October 30, 1971, the General Assembly in special session merged, without changing their names, the other ten state-supported senior institutions into the University as follows: Appalachian State University, East Carolina University, Elizabeth City State University, Fayetteville State University, North Carolina Agricultural and Technical State University, North Carolina Central University, North Carolina School of the Arts, Pembroke State University, Western Carolina University, and Winston-Salem State University. This merger became effective on July 1, 1972.

The Board of Trustees became the Board of Governors and the number was reduced to 35 members (32 after July 1,

1973) elected by the General Assembly. It is "responsible for the general determination, control, supervision, management, and governance of all affairs of the constituent institutions." However, each constituent institution has a local board of trustees of 13 members, eight of whom are appointed by the Board of Governors, four by the Governor, and one, the elected president of the student body, whose principal powers are exercised under a delegation form the Board of Governors.

Each institution has its own faculty and student body, and each is headed by a chancellor as its chief administrative officer. Unified general policy and appropriate allocation of function are effected by the Board of Governors and by the President with other administrative officers of the University. The General Administration office is located in Chapel Hill.

The chancellors of the constituent institutions are responsible to the President as the chief administrative and executive officer of The University of North Carolina.

Within the framework of higher education established by the state of North Carolina, Appalachian State University is dedicated to the total development of its constituency through instruction, research and service.

In pursuit of this purpose, Appalachian pledges itself:

To nurture an intellectual climate in which truth is sought and respected.

To provide a liberal education for all its students.

To offer, within the scope of its programs, pre-professional and professional education to those students who desire it.

To maintain a faculty dedicated to teaching and scholarship.

To advance the frontiers of knowledge through research.

To be cognizant of new knowledge and prepared to meet the challenge of new ideas.

To expand cultural horizons and develop appreciation to ethical and aesthetic values.

To make its resources available to the people within its sphere of influence.

To serve as a force for social improvement.

To cooperate with all institutions and agencies which are dedicated to the betterment of mankind.

IV. LIMITATIONS

Limitations of the study were as follows:

1. The curriculum in this study was developed at the request of the Chancellor of Appalachian State University and the Dean of the College of Business.

2. This curriculum was limited to training those persons who have obtained their four-year degree and to those who are in the process of earning this degree.

3. This curriculum in its present form will not lead to a degree in computer science at the university

as a major program in this area has not yet been granted by the General Assembly of the University of North Carolina System. This curriculum, however, would form the base to then be expanded to a degree program.

4. This study was limited to the upgrading or retraining of teachers already in the teaching field or those about to enter it. This curriculum is to teach them about data processing and to enable them to then teach data processing to their students.

5. This study was limited to supplying graduate and undergraduate students a research tool to be used in their studies and to give them general purpose knowledge about data processing.

V. DEFINITION OF TERMS

The following glossary was developed to clarify terms used in the study:

FORTRAN (Formula Translation). An automatic coding system designed to simplify the programming of scientific and engineering problems. The FORTRAN language closely parallels the language of mathematics.

COBOL (Common Business Oriented Language). An automatic coding system designed to simplify the programming of problems commercial in nature.

Machine Language. Information recorded in a form that a computer may use without prior translation.

Key punch. A key punch machine transfers information from coding sheets to cards and prints on the card the information punched into the card.

Verifier. A verifier checks the accuracy of key punching by "re-doing" the key punching process.

IBM. IBM is the accepted abbreviation for the International Business Machines Corporation. Throughout the study this abbreviation will be used.

S/360. S/360 is the accepted abbreviation for the IBM System/360 Computing System. Throughout the study this abbreviation will be used.

PL/1. An automatic coding system designed to simplify programming of problems on the S/360.

Accounting Machine. A unit record machine that reads punched cards and produces output in the form of a printed report.

Software. Software is the programming system used by a data processing operation (in addition to the computer) which includes assembler, compiler, and utility programs.

Sorter. A unit record machine that arranges cards in proper numerical or alphabetical sequence; this sequence may be ascending or descending.

Collator. A unit record machine that interfiles two sets of cards in sequence.

Reproducer. A unit record machine that can duplicate on a new card, in the same or different positions, all or part of the data in an existing card.

Flowchart. A graphic description or diagram of the flow of data within a program.

BAL (Basic Assembler Language). An automatic coding system designed to simplify programming of problems on the S/360.

Symbolic Language. A language that is based on machine language but allows the usage of mnemonics, symbolics, and special routines to aid in programming.

Systems Design. A detailed outline and description of procedures to follow in performing a prescribed record keeping task.

VI. PROCEDURES

The procedures followed to meet the objectives of the study were:

1. An extensive review of related literature was conducted.

2. A survey was made of the four-year degree programs in the state to determine what is available in data processing courses and a catalog description of each of the courses is presented in Appendix A.

3. A committee was established to have input into the development of the curriculum - among the members were the Director of the Computer Center at Appalachian State University who is also an Associate Professor of Business Administration in the College of Business and who has an extensive background not only in administration but also in teaching data processing courses, Dean of the College of Business, members of the Computer Policy and Advisory Council, and two faculty members from community colleges who are presently teaching data processing courses in their institutions. It should be noted that the author of the study has and is presently working in a data processing environment and has taught data processing courses on the graduate and undergraduate levels in senior institutions and also in the community college.

VII. ORGANIZATION OF THE STUDY

Chapter I includes the general background of the study, statement of the problem, importance of the

study, limitations of the study, definitions of terms used in the study, procedures, and organization of the study.

A review of related literature is presented in Chapter II.

Chapter III includes the curriculum and discussion of the courses.

Summary, recommendations, and implications of the study are presented in Chapter IV.

CHAPTER II

REVIEW OF THE RELATED LITERATURE

Data processing is the planned manipulation of facts and figures in such a way as to arrive at new and more meaningful information (DPMA, 1965).

The 1890 census spearheaded the birth of automatic data processing with Herman Hollerith's Census Machine. This machine tabulated automatically the census data that had previously been manually counted by census clerks. Improvements on this machine and new machines to do other tasks were developed. With each machine came a new demand for a faster and more accurate machine which resulted in the introduction of the first commercially available computer, UNIVAC I, in 1950. UNIVAC I was the beginning of the age of electronic data processing (Weiss, 1969).

Until 1950 no money had been spent by companies for computers. Then in 1950, fifteen computers were installed in the United States. There were more than 50,000 by 1968 with predictions that by 1980 there will be 350,000. Each installation requires a battery of personnel that must be educated and trained in electronic data processing (Weiss, 1969).

With the growth of the computer and the demand for more and more trained people, the implications for

business education are almost overwhelming. As one business educator wrote (Anonymous, 1969):

> Business has faced the fact that data processing is here to stay and the shape of things to come in the business world is already fairly well defined. No such situation exists in business education. To most business teachers, data processing, although it is no longer a strange term, is still a shadowy one that seems to cary a vague threat with it. Many teachers wish automation would go away and leave them alone p. 13 .

On the impact of the computer, Enoch Haga (1967) stated:

> There has been nothing like it in all our history. Automation amounts to nothing less than a technological revolution that cuts across the core of our existence. Even with our third-generation computers, we are just now at the threshold of the changes that are to come. Without computerization, we would be thrust back into the stone age. Our banking system might well collapse. Art and English and physical education students will feel the impact just as surely as business and mathematics students are feeling it now. Yet just a few years ago data processing was viewed with considerable hostility by some p. 16 .

Francis C. Gideon (1961) stated:

> The first Industrial Revolution was essentially a mechanization of the production process. It resulted in the freeing of man's hands from drudgery. The second Industrial Revolution will free man's mind from tedious, repetitive, uncreative tasks and thus permit him to extend his mental capabilities and scope of control p. 14 .

A survey was taken in 1968 (Bangs and Hillestad) of Vice Presidents in charge of planning, Data Processing Managers, and computer manufacturers to determine the

future of data processing. They offered these summarized views:

1. Miniaturization of computers has and will reduce the cost of computers and a greater percentage of smaller businesses will be able to afford electronic data processing in some form more than in the past.

2. Enlarged memory units will result in reduction in the need for exactness in programming, and machine languages will give way to the higher level languages, such as COBOL.

3. Advancements will take place more in the software rather than in the computer. The computer is not used to maximum efficiency today because of the slowness of input devices. Many new advances of the computer, and the use of the card as an input device will diminish.

4. As optical scanning becomes more prevalent, the need for persons for the job of coding will diminish.

5. Time sharing will increase. For smaller companies, input/output devices will be in their offices, giving access to a large processor at some other location.

6. Low-cost remote terminals will be available soon. Video data terminals are probably the greatest development thus far. They will reduce in cost during the next three to ten years making them practical for business usage.

7. A trend seems to be developing toward the necessity for the programmer to be an analyst in addition to his being able to program. This would indicate that the programmer will need to continue his training beyond a post-high school program to hold and advance in his job as a programmer.

8. The wiring concept is decreasing. Programming will be internal with the machine.

9. More sophisticated use will be made of the computer. Instead of using the computer simply to process accounting work, the machine will be used to aid management's decision-making activities.

10. Extreme shortage of skilled data processing personnel will continue, especially for programmers and systems analysts. Re-education and upgrading of employees will take place, with particular emphasis on systems personnel pp. 59-69 .

In a study by Adaline Jones (1966) to determine the occupations available and the employment requirements of the data processing occupation, she found that twenty-seven occupations were open to persons with no work experience and with little or no education or training beyond high school graduation. Such occupations were computer operators, magnetic tape librarians, electronic data processing control clerks, key punch operators, electronic accounting machine coders, office boys, stenographic occupations, and IBM department clerks, among others. A collegiate background was frequently necessary for occupations such as Manager of Computer Operations, Lead Procedures Analyst, Lead Programmer, Supervisor of Computer Operations, and the upperlevel positions.

Similar results were cited from a survey of data processing employers conducted by Stephen F. Hallem (1967). He found that the jobs available in data processing were divided into five basic classifications:

The first job classification was that of Data Control and Maintenance Personnel which comprised about 40 per cent of the total jobs surveyed. These jobs included clerical positions such as key punch operators, verifier operators, punched card file clerks, tape librarians, and other related jobs. A high school diploma was considered sufficient for initial employment in this classification. However, many employers predicted the phasing out of some of the clerical data processing jobs by technological improvements in computer systems.

The second classification consisted of auxiliary equipment operators, such as sorters, printers, listing machines, and other equipment which are auxiliary to the computer. Some operators need training in wiring the equipment, but that job is almost completely phased out in most firms. The majority of employers expect a decrease in the number of employees hired for these jobs.

The third classification was that of computer operators, which comprised about 18 per cent of the positions surveyed. Junior college or two years of university training was considered highly desirable. Since the computer operator is often hired as a potential programmer, college training could be a significant factor in promotion.

Programmers comprised about 16 per cent of the jobs surveyed. This is perhaps the most widely publicized

position in the field. The employers agreed that some post-high school training is almost essential. They predicted a trend in a rapid increase in the demand for programmers and were concerned about where they will be able to obtain them. They voiced a strong support for the junior college and technical institutes designed to train programmers. As a result of the enactment of the Vocational Education Act of 1963, the secondary schools and junior colleges have been provided an impetus for developing programs in data processing, but the question of who is responsible for teaching this subject may go unanswered for many years (Hallem, 1967).

Since this article was written, the 1963 Act has been amended. The Vocational Education Amendments of 1968 are discussed later in this chapter.

The fifth classification was that of systems analysts which accounted for 14 per cent of the employees in the survey. Although a college degree is strongly desired, the systems analyst's greatest asset is his experience. Companies ordinarily look to its programmers for future analysts who are promoted from within. Employers strongly support a program of cooperation between the local business firms and the local universities for a program of continued work-education in data processing.

In summary, the survey showed that it was important to teach basic terms and concepts fostered by the

electronic age. It is important that the student does not fear the computer and automation but rather realize the value of this new tool. Many employers were of the opinion that clerical skills such as key punching should be taught at the high school level. Other employers expressed the thought that technical training of this nature is primarily the responsibility of business and not that of the public high school. The survey concluded that there is a need for a well-developed program of education in data processing at the high school, junior college, and university levels. High schools should provide basic understanding of computer terminology, application, and operation. Junior colleges should train programmers and provide them with a general business background.

The development of vocational education was aided substantially by the Vocational Education Act of 1963. Funds were provided for vocational education programs at the state and local levels to equip students for gainful employment and included the business and office occupations heretofore not covered by previous acts. As a result, the employment opportunities increased in technical, professional, and semi-professional fields. This act was reviewed and amended in 1968 due to changes in labor markets and market demands.

Known as Vocational Education Amendments of 1968 (U. S. Congress), this act provided ways to keep vocational

education current in meeting new manpower needs. Among other provisions, the act created a National Advisory Council and State Advisory Councils and made moneys available for research and training in vocational education to establish cooperative vocational education programs and work programs. Title I, Part I, of the act dealt with curriculum development in vocational and technical education. It authorized $7,000,000 for fiscal year 1969 and $10,000,000 for fiscal year 1970 to be used:

> (a) to promote the development and dissemination of vocational education curriculum materials for use in teaching occupational subjects, including curriculums for new and changing occupational fields;
>
> (b) to develop standards for curriculum development in all occupational fields;
>
> (c) to coordinate efforts of the states in the preparation of curriculum materials and prepare current lists of curriculum materials available in all occupational fields;
>
> (d) to survey curriculum materials produced by other agencies of Government, including the Department of Defense;
>
> (e) to evaluate vocational-technical education curriculum materials and their uses; and
>
> (f) to train personnel in curriculum development p. 27 .

As to the question of where data processing belongs in the curriculum, all evidence tended to view the data processing curriculum structured under the business education department. Although orginally designed as a mathematical tool, the computer has seen its greatest

potential in business applications; and it seems logical from the literature that data processing will find its way into the business education department rather than in the mathematics or science departments.

Haga (1967) stated, "the business department has a good opportunity to take this course 'under its wing' but not to selfishly structure its content so as to make it unsuitable for non-business students p. 17 .

Added Merle Wood (1967):

> We have for so long taught a rather stereotype list of courses that we have found a great deal of stimulation from this newcomer to our list of subjects. The psychological effect of adding these courses to our department has real value. Because the equipment and theory of data processing are still somewhat magic to most people, our departments are gaining a good deal of status as we actuate these programs p. 3 .

Van Wagenen (1965) suggested that programs in business data processing attracted large numbers of students, especially the more able student, which presented a tremendous educational challenge. If business educators do not take the leadership, they may well lose their role of leadership in making important curricular adjustments so needed in a fast moving world of technological change.

Cautioned Merle Wood (1967), however, "our motive for setting up data processing courses must be to develop needed quality education and not simply to promote our field p. 2 ."

Many schools hesitate to plunge into the instruction of data processing because of the expense of the equipment; however, according to the study conducted by Dr. Bangs (1968), "hands-on training is probably more important psychologically to the prospective computer operator than for its learning value p. 65 ."

According to Merle Wood (1967), "a great deal of teaching of business data processing can take place without the use of the equipment. However, if vocational operational skill is to be developed, equipment needs to be used in the instruction program p. 44 ."

If computer programming is to be taught in depth, it is necessary that students have access to a computer. While there is some controversy regarding this point, business data processing can be taught on a small capacity, unsophisticated computer. One arrangement, according to Merle Wood (1967), would be that of time sharing. During the day and early evening hours, the equipment is available for the use of the school administration. Care must be taken, cautions Wood (1967), that these two divergent uses do not compete. The basic reason for having the equipment must be instructional, and this must have priority.

Most state departments of instruction are doing everything possible to encourage schools to begin to automate their record systems, and this change is indeed

long overdue. However, if the prime motive for getting data processing equipment is to process data while instructional usage is of secondary importance, then difficulty is bound to develop.

From a study by Dr. Bangs (1968), it was found that secondary schools' equipment tended to be unit record equipment, including key punches, sorters, accounting machines, reproducers, and collators. One-third of the high schools included in the study reported having a computer available for instruction, but over 80 per cent of the post high schools indicated the availability of a computer for instruction. The equipment with which the students worked tended to be in the school in which the students were located, except in the high schools. Forty out of sixty-six reporting to own data processing equipment reported that it was centralized in a single school or in an administrative unit.

When debating the issue of equipment to be used in the teaching of data processing, the question inevitably arises as to the sources of equipment and funds for establishing and maintaining the program. Four main sources were found by Dr. Bangs (1968) for acquisition of equipment and supplies. They were the provisions of the National Defense Education Act, funds provided by the Vocational Education Act, Manpower Development and Training

Act, and state and local funds. Generally the schools purchased, rented, or leased their equipment; however, some reported that the equipment was donated to the school by business firms. Generally the post high schools had more equipment available for instruction than did high schools, especially computers and peripheral equipment.

There is a great deal of controversy as to whether the best policy is to lease or purchase equipment. Leasing computer and unit record equipment makes it possible to upgrade equipment with little loss. Leasing also provides for close liaison with the machine company representative. Maintenance is provided under most lease contracts, and so repairs are easily available and are at a fixed cost. Because of the possible loss of state funds due to changing laws, however, a school district may feel that the purchase of equipment will give the program stability which it might not otherwise have. There are a number of arguments for both procedures, and they can only be solved on the basis of the particular objectives and issues in each individual situation.

Many of the new occupations in data processing are ill-defined and in a state of development themselves. Programming is obviously a significant part of any data processing organization and the most widely publicized, but other career opportunities should be examined, such as computer operations, computer systems, analysis, and the

clerical occupations that require only high school training for first level entry.

According to Parfet (1962), "it is not enough that we teach typewriting, shorthand and bookkeeping and then push our students out the door, letting them wander from office to office without knowing what they are looking for or what opportunities await them p. 31 ." Each individual school system will have to decide for itself what to teach about data processing, how much time to spend on the selected topics, and which teaching devices to use. Objectives should be set in relation to the community in which students seek employment when they finish.

Dr. Bangs (1968) found that the respondents in his survey reported that the primary objective of data processing instruction in all three types of schools interviewed (high schools, technical institutes, and junior colleges) was to provide vocational preparation in the field of data processing. Only twenty-three responses out of one hundred and seventy-seven indicated that the primary objective of data processing instruction was to provide a general knowledge about data processing or to provide acquaintanceship level of machine operating skill. It is the belief of Dr. Bangs (1968) that the high school curriculum should be designed to meet two objectives: first, that the student will have enough academic credits to be admitted to college should he decide to attend; and

secondly, that the student will be able to enter into a beginning job in a data processing department upon the completion of the program. He further believes that a general introductory course in computer concepts would be of value to every student. Such a course should also be offered as a part of a continuing education program as a service to the entire community.

The question of whether to teach basic computer concepts or machine skills has been debated for quite some time with no concrete answer forth coming. Jones (1966) offered this thought:

> Diversity in employment requirements and the confusing computer technology is in a rapidly developing stage, making the task of designing appropriate programs for preparation of workers an overwhelming one. A worker needs to be able to take employment in several occupations, partly because there are so many different occupations, partly because there are relatively few workers needed in any given occupation, and partly because those occupations which exist today may be replaced by occupations with entirely different employment requirements p. 18 .

Dr. Bangs (1968) presented in his study some general recommendations by employees to schools concerning the instruction in data processing that should be offered. The employees recommended that mathematics, accounting, unit record equipment, data processing concepts, a rounded business education program, data processing applications, and logic be included. They recommended that instruction

begin in the high school and that preparation on the key punch machine should be included in the school curriculum.

It was found that the high schools were offering mainly three courses in their data processing program: Introduction to Data Processing, Unit Record Systems and Equipment, and Data Processing Applications. The introduction course seemed to be a rather broad course covering the field of data processing at least to the extent that the student might develop a "feel" for what data processing is. The topics developed included basically an overview of the concept of unit record systems and the functions of the machines involved in such systems.

According to Adaline Jones (1965), "one is forced to conclude that the student can best be served by being provided with that type of education which will assure him flexibility in the labor market p. 240 ." The program should emphasize the fact that the rapidly developing computer technology causes changes in the duties and operations the employee will perform from time to time. The student entering the field of data processing as a career should be made aware of the fact that if he is able to retain his employment, he will have to be involved often in programs on continuing education.

The long-range effect of electronic data processing will be felt most strongly in the fields of bookkeeping and accounting; therefore, courses in these fields must

keep pace. Sister M. Catherine (1964) felt that the business education curriculum should be expanded to include a one-semester course in basic data processing techniques. The emphasis in this course would be on an introduction to the functions of the electronic data processing machines. At present, industry is training the people it needs; it would be to the advantage of those who plan to enter the field to have some background in the equipment, even on a purely theoretical basis.

As the outcome of his extensive survey, Dr. Bangs (1968) recommended the following data processing curriculum for the high school:

Ninth Grade

Mathematics
English
Social Science
Typing
Physical Education

Tenth Grade

Mathematics
English
Social Science
Introduction to Data Processing
Physical Education
* (Electives: Introduction to Business
Consumer Economics)

Eleventh Grade

Advanced Algebra
English
Social Science
Computer Concepts and Systems
Development
Bookkeeping
Physical Education

Twelfth Grade

Oral Communications
Written Communications
Business Organization and Management
Human Relations
Business and Office Procedures and
Data Processing Applications
** (Elective: Economics) pp. 3-4 .

In the Introduction to Data Processing course, the specific topics and concepts to be included were: (1) history of records systems and manual data processing, (2) tabulating cares and equipment--operation and purposes, excluding panel wiring, (3) electronic computer--logic, memory, input of data, calculation and output, (4) flow-charting and computer operation using the type and model of computer and a symbolic language for which the teacher and student have access.

On the community college level, Dr. Bangs (1968) recommended:

First Year

First Semester:

College Algebra
Written Communications
Accounting Principles
Introduction to Data Processing
Principles of Economics

Second Semester:

Data Processing Mathematics
Oral Communications
Accounting Principles
Business Conditions
Logic and Introduction to Systems
Analysis

Second Year

First Semester:

Business Statistics
Psychology
Advanced Accounting
Introduction to Computer
  Programming
Data Processing Systems

Second Semester:

Principles of Management
Human Relations
Data Processing Applications and
  Practicum in Programming
Advanced Programming p. 5 .

Typewriting was considered a prerequisite to this program.

Basic background courses are just as important for the student who will enter the data processing field as the computer concept and application courses. Dr. Bangs (1968) stated that "essential background should be provided in how business is organized, how it operates, and how its records are kept; together with good communications skills and knowledge of human relations p. 80 ." He further stated that "for some time data processing personnel lived in a world that was basically its own, with its own language. That day has passed, and now the data processing personnel is recognizing that it is a function for the total success of the business p. 80 ."

According to Dr. Bangs (1968), understanding people and knowing the principles of human relations were

very important. Written communications should emphasize expository writing rather than the usual English writing course emphasizing literary or creative writing. Much business information resulting from data processing will be in numerical form and must be interpreted for the reader. Report writing needs to be stressed as well as ability to express oneself clearly through business letters, directives, and memorandums.

In a further attempt to determine the background courses necessary for success in data processing, Dr. Bangs (1968) interviewed data processing employees, asking them to evaluate their high school and college (if any) backgrounds. He found that employees in all levels reported that general mathematics was considered the most valuable course taken in high school. English and general mathematics were considered to be the second most helpful general education courses taken by all data processing personnel. Advanced mathematics was considered the most helpful general course taken by the upper positions, which included programmers, systems analysts, and managers. Other general courses listed by the employees as being helpful were typing (especially key punch operators), business mathematics, bookkeeping, and introduction to business.

Of the post high school courses taken, employees' responses closely paralleled with those mentioned by data

processing employees evaluating their high school work. General mathematics was the most frequently mentioned, with English ranking second. The social science courses, especially psychology, appeared as valuable courses. With regard to business courses, Data Processing Equipment was listed more than twice as many times as any other business course. Shorthand was most frequently mentioned as the least helpful.

The two methods used most extensively for introducing data processing are the "integrative approach" and the "individual self-contained course." The major implications from the literature indicate that the important factor is that the concepts be introduced, regardless of whether they are taught in a separate course or integrated into other business courses. Many authors have presented ideas for implementing the data processing concepts in courses such as bookkeeping, office practice, office machines and management. As one instructor phrased it (Wood, 1967):

> A few days or even a few weeks of teaching a related data processing unit in one of our existing courses can be as refreshing as spring vacation. It isn't necessary to have a room full of expensive equipment in order to teach a good deal about data processing p. 3 .

One suggestion for a one-semester course would be to offer the course as a team-taught course. During the

first half semester all students would be in the class together, and it would be taught by a team of two teachers--one business teacher and one mathematics or science teacher. The basic theory can be explained during this first nine-week session. During the second nine weeks, the class can be broken into two sections. The business students would progress with their business teacher into topics of business data processing and systems work, while the other member of the teaching team would expose his group to scientific applications.

Deciding which students will be capable of success in the data processing field poses another problem for educators. Various entrance requirements have been established whereby schools select the students who will qualify for instruction in data processing. From a study conducted by Mona Carlberg (1965), it was found that all but one school included in the survey based their selection on aptitude tests made available by machine manufacturers. One school required students to have at least a C average in all subjects plus a minimum IQ of 105. Some schools required students to have a typing rate of at least forty words per minute.

Many students are attracted to programming without knowing very much about it. IBM's Aptitude Tests are widely used in industry; but says Greene (1969), "this test may not have much validity for the student in high school

with a limited background in business and unformed ideas about his own interests and abilities p. 28 ."

Greene (1968) continued that hard and fast rules often work to the disadvantage of certain individuals. At the same time, there must be some guidelines. Many schools have discovered that the most significant indicator of a student's ability is his prior school grades and the anecdotal notes of teachers and counselors. A genuine interest on the part of the student is one criterion that cannot be overlooked.

Merle Wood (1967) suggested the following entrance standards as defensible criteria: (1) for key punch operator, a typing rate of forty net words per minute; (2) for tabulator equipment operator, average grades and the anecdotal notes of teachers and counselors; (3) for computer programmer, a grade average of B or better and one year of algebra as a prerequisite. For a non-vocational, one-semester introductory course, Wood (1967) would suggest that no entrance requirement be imposed other than having a genuine interest.

Bangs (1968) found, just as did Wood, that over one-third of the reporting schools in his study screened students for entry into the program. High schools tended to be more selective than the post high schools with slightly over 70 per cent of the high schools using some criteria for selection of students, while only about 45 per

cent of the post high schools reported having admission standards. The most popular method of selecting students was again on the basis of test scores. To a certain extent, mathematics was a prerequisite, especially in the vocational-technical schools. Typing ranked as the second prerequisite by the high schools and vocational schools, while only five junior colleges named typing as a course necessary for entrance. Bookkeeping and accounting were required for entry by one-fourth of the high schools and only one-eighth of the junior colleges.

In an attempt to find the desirable characteristics of data processing students, Dr. Bangs (1968) interviewed teachers of data processing. Their most frequently mentioned characteristic was that these students showed a greater degree of neatness in their work than other students. Next most mentioned was that of persistence on the part of these students in problem solving. They were not content to leave a problem until it was complete. Students of data processing tended to pay attention to detail, were logical thinkers, and displayed systematic work habits. Other characteristics often mentioned were that they were eager and interested, creative, and some reported a tendency for students to be "machine happy," or excited about making the machine carry out their instruction (Carlberg, 1965).

One of the most critical problems faced by school

administrators is the shortage of qualified data processing teachers. Most schools try to prepare their own business teachers for this area. Because industry is eager for schools to take over the job of training employees, many companies are willing to make special arrangements to provide free instruction for teachers through training programs. In most schools the data processing program is integrated with the office training program, and the instructors work together on the complete program (Bangs, 1968).

Qualifications for data processing teachers will differ with each type of program. However, because business data processing relates almost entirely to business processes, it is appropriate to select a business teacher to conduct these courses. Their basic reference is going to be to accounting applications, and a good solid accounting background is recommended. There are a number of references to mathematics, and it would be advantageous for the teacher to have an aptitude for mathematics. It was not recommended, however, that a mathematics teacher be assigned this course unless scientific data processing is to be taught because it is an entirely different field (Wood, 1967).

In listing the personal qualifications for the data processing teacher, Wood (1967) suggested that the teacher have a flair for creativity, a sense of logic, and

a feeling for the systematic solution to problems. She should be inquisitive, resourceful, and thoroughly sold on data processing. Because of the changing nature of data processing, she should be willing to continue to learn.

In the way of professional qualifications, Wood (1967) stated that "it is safe to say that a well-oriented data processing teacher needs about 1,000 hours of instruction p. 41 ." Assuming that the teacher is already a competent business teacher, Wood (1967) suggested the following areas of training: (1) for key punch teacher, 35 hours: (2) for tab equipment operator teacher, 140 hours; (3) and for computer programmer teacher, 1,000 hours.

From an actual study (Bangs, 1968) of data processing teachers, it was found that a greater proportion of the high school teachers with at least a bachelor's degree declared business or business education as a major than did teachers at the post high school level. Mathematics and science accounted for a larger percentage of the majors completed by the post high school teachers.

Mona Carlberg (1965) found that:

> Most schools required their teachers in data processing to have their master's degree. Other considerations were their experience in business and industry in the field of data processing, their training, and their references. Most teachers received their training from IBM schools or educational centers and through special vocational training in colleges and universities p. 17 .

Dr. Bangs (1968) found that over half the teachers interviewed had acquired at least some of their background by attending manufacturers' schools. More than half again as many post high school teachers than high school teachers had work experience, and a slightly greater percentage of the junior college and vocational-technical teachers had used programmed textbooks on their own than had the high school teachers.

On the point of work experience in data processing, 60 per cent of all teachers reported at least one year employment in data processing; and many of them had worked in data processing more than eight years. Among high school teachers, however, only slightly over half had any work experience in data processing at all; and 60 per cent did not have over a year's experience.

The courses studied by teachers tended to be mainly in the unit record area, especially among the high school teachers. Post secondary teachers concentrated more in the computer and programming areas. Several different means were reported for updating themselves, which included reading periodicals, attending summer sessions, attending professional meetings and manufacturers' schools, and working in data processing during the summer months.

Post high school teachers tend to teach a greater variety of data processing courses, while high school

teachers are involved in more courses outside the field of data processing. At the high school level, the course most frequently taught outside the data processing area was bookkeeping or accounting and typewriting. On the post high school level, mathematics was the course taught outside of data processing by the data processing instructors. On the average, however, 22 per cent of the teachers in the secondary school and over 35 per cent on the junior college level teach only in the data processing field.

The review of related literature would be incomplete if some mention was not made of a project unique to the state on which the present study is based. Three large four-year institutions formed a computer services organization to provide computing services to all public or private educational institutions whether they be two-year or four-year universities, community colleges, junior colleges, or technical institutes throughout the state. According to an interview with the director, Lewis T. Parker, Jr., the project began in May, 1966, and ended October, 1969, during which time every institution in the state was offered free computing service on a S/360 via a remote terminal on a one-year trial basis. Out of approximately one hundred eligible institutions, fourty-three participated, with thirty-two retaining their participation after the free period was terminated.

Among the objectives of this project was to arouse an interest in computer science aiming to standardize both instruction and usage and thereby improve instructional quality. Another important phase of the project dealt with the instructing and aiding of faculty and students using the facilities; the basic concern being with educational and not administrative applications.

This project, though now expired, is relative to this study in its effect on the computer science courses available in the state. The effect, of course, has not yet been totally felt. The project was replaced with a permanent group funded by National Science Foundation providing various educational services relative to computing science; one service being in the area of curriculum development. The change resulting from the project was inevitable as smaller, less wealthy schools now had available to them a computer for instructional purposes. This then meant adding new courses to present curricula or restructuring present courses or in some instances both. Seeing these needs, the new group provided funds for group leaders during 1969-1970 in business education, chemistry, engineering, mathematics, physics, and statistics. The greatest strides being made in the areas of chemistry, engineering, sociology, and statistics. Four new areas, biology, data processing, humanities, and sociology are now under consideration to be funded.

The development program has taken on the form of group activities, workshops, consulting services, teaching unit production, and publication of a program and literature service journal. These services will be terminated in 1971, and sole responsibility for curriculum development will then be placed on the various institutions.

The most important fact arising from this project is that thirty institutions (including one high school system), who had no on-campus computer, now have available for use a major system at low cost.

CHAPTER III

PRESENTATION AND DISCUSSION OF THE CURRICULUM

I. INTRODUCTION

It was the purpose of this study to develop a curriculum to train teachers to teach the various facets of data processing on the high school, vocational-technical institute, or community college level and to develop courses which meet the needs of undergraduate and graduate students in the fields of business administration, education, psychology, sociology, and the sciences at Appalachian State University.

Before the proposed curriculum presented in this study was developed, a survey was made of the four-year degree programs in the state to determine what was available in data processing courses. The survey was limited to courses offered through the business education departments and/or education departments. A complete listing and catalogue description of each of these courses is given in Appendix A.

The survey encompassed the curricula from forty-three institutions. Three of these schools offered extensive training in data processing in which a major could be obtained. Twenty-three colleges offered no courses through their business education or education

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departments. The remaining seventeen schools offered, on the average, one or two one-semester introductory courses. It should be noted that one institution offers a data processing course geared to the needs of educational administrators; however, no courses are offered particularly for the teacher of data processing.

Based on the review of related literature and the curricula structures of the other institutions in the state, the following basic data processing curriculum was developed.

II. COURSE I - PRINCIPLES OF AUTOMATIC DATA PROCESSING

Principles of Automatic Data Processing, Course I, has as its objectives to help foster in the student an understanding of the theory, principles, and technical aspects of automatic data processing and acquisition of skill in wiring the basic unit record machines. The student will also be given applications and experience in operating the unit record machines and an understanding of their uses in business. An introduction to computers, systems analysis, and flowcharts is included in this course to aid the student in deciding if he should continue in his pursuit of knowledge in data processing rather than to continue for two or three semesters before realizing his interests, needs, and/or talents do not lie in this field.

This course is primarily planned for students majoring in business education and secretarial administration. It is appropriate, however, for any student interested in data processing.

At the request of the head of the department, this course was given a grade level of III (junior level) and is not open to freshman students. Credit given for the course is set for four semester hours with three hours of lecture and two hours of laboratory weekly.

Topics covered in the course include an introduction to data processing. Historical background along with the development of the punched card, card layout and design, and card code will be covered.

The second topic deals with the recording of source information. The student will study the operating features of the IBM key punch machine and will learn to operate it for alphabetic and numeric fields, field definition, and skipping and duplication of data.

Classification of information by sorting is the third topic. Operating features of two models of IBM sorters will be discussed along with procedures for the sorting of numeric data and alphabetic data. Special features of the IBM 83 sorter will be pointed out.

The next step deals with the preparation of reports. Operational features of the IBM 402 and 403 accounting machines will be presented along with the principles of

control panel wiring and carriage control. Multiple line printing on the 403 accounting machine will also be discussed.

The collation of sorted data is the next topic. The operational features and control panel wiring principles of the IBM 85 and 87 collators will be taught in conjunction with typical operations performed by the collator.

The subject of reproduction of recorded information is discussed in reference to the IBM 513 and 514 reproducing punches. The reproducer's operating principles and its capabilities of reproducing, gangpunching, verifying, mark sensing, and summary punching are presented. The operating principles of the IBM 548 interpreter are also discussed at this time.

The last two topics covered in this course are an introduction to computers and an introduction to systems. An introduction to system analysis and system flowcharts are presented along with an introduction to operational principles of a computer and some sample applications.

A list of suggested texts and references is given at the end of Course Outline 1, Appendix B.

Students are given the opportunity to gain practical experience on the machines presented in the course during the two one-hour weekly laboratory periods that are scheduled.

III. COURSE II - FORTRAN PROGRAMMING

FORTRAN Programming is an undergraduate FORTRAN Course which will help develop the student's ability to solve statistical and other mathematics-related problems through the use of a scientific language. Upon completion of the course, the student will be able to code, compile, test, and debug simple FORTRAN IV problems to be run on the university computer center's equipment. The student will also learn to use systematic techniques to solve a computer programming problem form definition, problem analysis, flowcharting, to documentation.

This course is intended primarily for sophomores and juniors majoring in science and mathematics and was hence given a grade level of III. Three semester hours credit was established with three hours lecture a week and one hour laboratory period a week. As a prerequisite, the student should have a basic knowledge of algebra.

In this course the student will be introduced to digital computers, their history and features including storage, the stored program, addresses, control unit, arithmetic unit, binary arithmetic, and input and output.

The next topic to be covered is the FORTRAN language. The basic elements of the language with regard to constants, variables, arrays and subscripts, expressions, and statement formats will be discussed. Control state-

ments, INPUT/OUTPUT statements, and specification statements will be presented in detail.

Some examples of slected exercises to be programmed in the FORTRAN language are:

A. Solution to simultaneous linear equations

B. Mean and standard deviation

C. Correlation

D. CHI square

E. Matrix operations - including inversion

F. Regression analysis

This is only a partial listing of exercises which will be programmed. The primary emphasis in this course is on programming in the FORTRAN language rather than on specific applications.

A list of basic texts and important references for the course is given at the end of Course Outline II, Appendix B.

IV. COURSE III - ELECTRONIC DATA PROCESSING I

Course III, Electronic Data Processing I, provides the student with an introduction to the major concepts and characteristics of data processing. The developments in calculating machines which led up to the introduction of modern computers and a diagram of the functional organization of a computer will be described.

The objectives of this course include providing the student with an explanation of how a basic computer program operates and describe the major design objectives of at least three programming languages. It also aims to provide the student with an understanding of data processing terminology which will enable the student to carry on a meaningful discussion with data processing personnel.

This course is planned for advanced undergraduate and graduate students and has been assigned a grade level of V. Three semester hours credit is given for the course requiring three hours of lecture per week.

Specific topics covered in the course include the history of calculating machines and the development of electronic computers. The student will then be introduced to the computer industry. Specific manufacturers will be discussed in regard to development, type of machines, rank in the industry, and market strategy. Positions in the computer industry will also be presented.

The next step introduces the student to the various activities required in programming, coding, and systems analysis.

A brief introduction to FORTRAN, COBOL, and other programming languages is planned at this point to provide the student with an understanding of what languages are and how one differs from another. Software systems and the

specifications and documentation of computer programs are also discussed.

The next topic deals with the hardware of a computer including unit record and magnetic input/output devices and how a computer operates.

Distinctions will be made between business and scientific data processing and the various types of files and records associated with each.

The final topic covered is computer systems. The student will study a computer center and learn how it operates. He will learn about teleprocessing and real-time computing along with multiprogramming and time sharing.

A list of basic texts and important references for this course is provided at the end of Course Outline III, Appendix B.

V. COURSE IV - ELECTRONIC DATA PROCESSING II

The fourth course in the curriculum, Electronic Data Processing II, introduces the student to basic assembler language (BAL) for the IBM S/360 and RCA SPECTRA 70 computers. The instructions and capabilities of the language are covered in detail. Upon completion of the course, the student will be able to code, compile, test and debug simple BAL problems to be run on the university computer center's equipment.

This course is planned for advanced undergraduate and graduate students who have taken Electronic Data Processing I. The grade level of the course is V (graduate level), and three semester hours credit is given. The course requires three hours of lecture per week and informal laboratory periods.

The first topic will introduce the student to the various operation codes of the language and its coding conventions and structure. Terms, expressions, and the addressing feature of the language are discussed.

Machine instructions and assembler instruction statements are gone into in great depth to provide the student with the skill necessary to solve problems using the BAL language. Specific topics are listed in the Course Outline for this course in Appendix B along with a list of basic texts and important references.

VI. COURSE V - COBOL PROGRAMMING

Course V, COBOL Programming, has as its objective to develop the student's ability to solve business related problems with the use of digital computer techniques. Upon completion of the course, the student will be able to code, compile, test, and debug simple COBOL problems to be run on the university computer center's equipment.

This course is intended primarily for juniors and seniors in the School of Business and for graduate students

with approval of advisor. Grade level for the course is V, and credit is three semester hours. The student must have taken Electronic Data Processing I or have approval of the instructor to enroll in the class.

The student will be introduced to COBOL in regard to its history, COBOL general, and COBOL for the S/360. Elements of the language such as sections, paragraphs, entries, literals, and character sets will be discussed.

The four divisions of COBOL, identification, environmental, data, and procedural, will be discussed in depth. Sample workshop problems to be programmed in COBOL include inventory update, report card, accounts receivable, and capital equipment depreciation.

A list of basic texts and important references are given at the end of Course Outline V, Appendix B.

VII. COURSE VI - SYSTEMS DESIGN AND ANALYSIS

Systems Design and Analysis, Course VI, will enable the student to develop a systems solution that includes documentation of input, output, data flow, and a general description of runs and logic. This course will also develop the student's ability to consider programming systems options and equipment usage.

The course is primarily for seniors and graduate students majoring in Business Administration and Educational Administration.

A grade level of V and three semester hours credit have been assigned this course. The prerequisites include a course in programming digital computers using the COBOL or FORTRAN languages.

The first topic covered will be development and use of documentation techniques including the use, improvements, and refinements of documentation forms.

Understanding an existing system is the next topic which will give the student the necessary information on documenting a survey. A non-mechanized system will be covered including the necessary information sheets such as resource usage, activity, operations, message, and file.

The third topic of the course deals with determining systems requirements. Analysis of requirements including need for requirements, sources of information, determinates, documentation forms, and use of forms will be discussed. Determining requirements for both a mechanized system and a non-mechanized system and then developing these requirements will be incorporated in this topic.

Describing the new system is the next step. Included in this topic is systems design, sources of information, communicating details of the new system, and describing the projected system.

The final subject is programming the new system which included method of work, general programming rules, and programming rules for t[redacted]/360.

A list of basic texts and important references may be found at the end of Course Outline VI, Appendix B.

VII. COURSE VII - APPLICATION OF DIGITAL COMPUTERS AS AN INSTRUMENT FOR RESEARCH

Course VII, Application of Digital Computers as an Instrument for Research, will introduce the student to mathematical calculations using the FORTRAN IV language with heavy emphasis placed on developing the student's ability to use library programs and systems such as IBM GPSS (General Purpose Simulation System) and University of California at Los Angeles statistical programming system. The course covers the formulation of numerical problems in the FORTRAN IV language for solution on digital computers related to business, science, education, and the behavioral sciences. The student will be required to implement statistical applications requiring the integration of data processing and analytical programming techniques.

This course is Grade V level and is intended primarily for advanced undergraduate students and graduate students in behavioral science, education, science, and business administration.

Credit for the course is three semester hours with three hours lecture per week and one hour laboratory period per week. The student must have completed Electronic Data

Processing I and have a basic knowledge of algebra and statistics or consent of the instructor.

The student will be introduced to the key punch machine so that he can punch his program cards; he will then be introduced to the control systems available to him: TUCC, IBM S/360, and RCA SPECTRA 70.

An introduction to FORTRAN IV is the next step. Among the topics covered are the features of the language for the S/360, for TUCC, for RCA SPECTRA 70, and subsets. Punched card input, arithmetic operations, standard functions, and printed output will be discussed. Definition of functions, manipulation of single-subscripted variables, magnetic tape input and output will be covered along with manipulation of two- and three-dimensional arrays.

Selected exercises to be programmed in the FORTRAN language include mean, variance, standard deviation, linear regression and correlation, Spearman rank correlation, Kendall rank correlation, and biserial coefficient of correlation.

A list of basic texts and important references is given at the end of Course Outline VII, Appendix B.

IX. COURSE VIII - AUTOMATIC DATA PROCESSING FOR BUSINESS TEACHERS

Course VIII, Automatic Data Processing for Business Teachers, emphasizes the teaching problems and

procedures of understanding the theory, principles, and technical aspects of automatic data processing and acquisition of skill in wiring the basic unit record machines. The student will gain experience in operating the unit record machines and an understanding of their uses in business. He will also be introduced to systems analysis and flowcharts.

The course is planned to prepare business teachers to provide an ihstructional program in automatic data processing in high schools, technical institutes, and community colleges.

A grade level of VI is assigned to this course with four semester hours credit requiring three hours of lecture per week and two hours of laboratory per week. The prerequisite for the course is graduate status.

Topics covered in the course include an introduction to data processing, historical background, the punched card, card layout and design, and card code, and various teaching problems and procedures related to them.

The next topic involves the recording of source information on the IBM key punch machine. Teaching problems and procedures related to the key punch are discussed.

The problems and procedures of teaching the classification of information by sorting is the third topic.

This covers both numeric sorting and alphabetic sorting on the IBM 82 and 83 sorters.

The operational features of the IBM 402 and 403 accounting machines including control panel wiring, carriage control, and multiple line printing are approached from the teaching aspect as is the collator, reproducer, and interpreter.

The final topic introduces the student to system analysis and system flowcharts.

A list of basic texts and important references is given at the end of Course Outline VIII, Appendix B.

CHAPTER IV

SUMMARY, RECOMMENDATIONS, AND IMPLICATIONS

Summary

It was the purpose of this study to present a curriculum for Appalachian State University to train teachers to teach the various facets of data processing on the high school, vocational-technical institute, or community college level and to develop courses which would meet the needs of undergraduate and graduate students in the fields of business administration, education, psychology, sociology, and the sciences.

The following career paths are recommended.

The teacher already in the field who has been assigned to the computer science department but has no experience in computers would take the following sequence courses:

1. Automatic Data Processing for Business Teachers
2. Electronic Data Processing I
3. Electronic Data Processing II
4. COBOL Programming
5. Application of Digital Computers as an Instrument for Research
6. Systems Design and Analysis

The following courses may be taken one per semester, or the first two may be taken during the same

semester. The next semester the teacher might take the next two courses, and the third semester take the next two courses. A methods course in electronic data processing was not deemed necessary at this time by the department head at Appalachian State University on the grounds that the methods courses taken in undergraduate school by the teacher coupled with the knowledge gained in the computer science curriculum would be sufficient.

The undergraduate student majoring in business education who is planning to teach data processing upon graduation would take the following series of courses:

1. Principles of Automatic Data Processing
2. FORTRAN Programming
3. Electronic Data Processing I
4. Electronic Data Processing II
5. COBOL Programming
6. Systems Design and Analysis

These courses would be integrated into the student's regular schedule of required courses which would dictate when the courses would be taken.

The student majoring in business administration would be recommended to take:

1. Electronic Data Processing I
2. COBOL Programming
3. Systems Design and Analysis

The graduate student majoring in education would take the following data processing courses for research competency:

1. Electronic Data Processing I
2. Application of Digital Computers as an Instrument for Research

The graduate student in Educational Administration and Supervision would take:

1. Electronic Data Processing I
2. Application of Digital Computers as an Instrument for Research

Undergraduate students in physics, engineering, chemistry, and the various sciences would be recommended to take FORTRAN Programming and could take any other courses they so elected.

Recommendations

As was stated previously, this curriculum is not intended to be accepted in its entirety for all institutions nor is it to be considered a complete computer science curriculum. The courses were developed with a particular institution in mind, and its needs were what were considered. The curriculum could be used, however, by other institutions with certain modifications.

The future developments for this curriculum might be the addition of more lecture courses in such

areas as Programming Language/1, Report Program Generation, implications in data processing for education, introduction to operations research, linear programming, and simulation.

Other areas to be investigated should be the use of programmed instructional materials and the use of video instructional techniques. Both of these areas are a growing part of the computer industry and are gaining wide-spread use in business and industry as training aids. With little adaptation, they can be used in educational institutions.

Implications

This study has produced significant change within Appalachian State University. It has been presented and accepted by the Curriculum Committee as one of the documents being used in the development of the guidelines for a major in data processing in the College of Business. This is considered significant in that the computer has become an integral part of society and the demands for trained personnel to design systems, program, maintain the equipment, educate people about computers, and develop new techniques are ever growing.

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APPENDIXES

APPENDIX A

DATA PROCESSING COURSES AND CATALOG DESCRIPTIONS

FROM OTHER FOUR-YEAR INSTITUTIONS

College A

Business 465: Introduction to Automatic Data Processing

Card designing, key punching, sorting, tabulating, and preparation of reports. Application to problems in business and economics.

Business 466: Advanced Business Data Processing

Advanced problems in the use of the unit record system. Preparation of flow charts and systems design.
Prerequisite: Business 465.

Business 467: Electronic Data Processing

Introduction to computers. Programming digital computers for business applications. An assembly language and the operation of a modern computer are included.
Prerequisite: Business 465.

College B

Business 215: Introduction to Data Processing

A basic course in the fundamental concepts and operational principles of data processing systems.

Business 15 (Math 215): Data Processing and Computer Fundamentals

The business survey, systems design, system manual, automatic data processing, electric data processing, computer fundamentals, and machine application.

College C

No courses offered

College D

Business 225: Card Punch Operation

Training is provided in programming and in punching cards for unit record data processing systems. Individualized instruction is provided through programmed materials.
Prerequisite: one semester of typewriting.

Business 436: Introduction to Data Processing

The course includes an introduction to computer concepts and language and experience with unit record equipment: the printing card punch, the sorter, and the accounting machine.

College E

No courses offered

College F

No courses offered

College G

No courses offered

College H

No courses offered

College I

No courses offered

College J

Business Administration 151: Computer Data Processing for Business

Includes data processing fundamentals, equipment, programming, and systems. The basic

concept of data flow, machine-processable data, and data organization are related to electronic equipment and programming techniques used in business.

College K

Business 50-431: Data Processing I

Primary uses and techniques involved in operating data processing equipment. Emphasis on developing skill in alpha-numeric key punching, verifying, procedures for operating sorters, the collator, the interpreter, and the accounting machine.

Business 50-432: Data Processing II

Introduction to planning and programming in applying data processing equipment to simple clerical problems. Emphasis on coding, panel wiring, scheduling work flow.

College L

Business Administration 327: Survey of Data Processing

An introduction to the functions and potentialities of general purpose digital computers. Includes histroy and nature of equipment, data storage, computer operations, systems design, applications planning, and programming concepts, and impact upon society.
Prerequisite: Junior standing.

Business Administration 328: Practical Application of Data Processing

Group projects involving inquiry into the existing and anticipated data processing problems of area institutions. Lectures, discussions, workbooks, and programmed instruction materials and visits to operating organizations in the area. Must be taken in conjunction with Business Administration 327.

College M

Data Processing 221: Basic Machine Operation and Wiring

This course is designed to acquaint the student with the theory and principles of electronic data processing. Classroom and laboratory instruction is given in the fundamentals of IBM accounting, IBM card reading, card punches 26, 29; sorters 82, 83; introduction to control panel wiring; interpreters 548, 552; reproducers 85, 87.

Data Processing 222: 402 Accounting Machine

This course is a continuation of Data Processing 221. Is designed to acquaint the student with the theory and principles of electronic data processing. Classroom and laboratory instruction is given in the planning chart, digital selection, group printing, setup change, hammerlock control, counter coupling, total transfer, group indication, field selection, class selection, carriage control, summary punching, runout buttons and switches, space control, inverted forms, multiple line printing, and case studies.
Prerequisite: Data Processing 221.

Data Processing 331: Basic Computer Systems Principles

This course is designed to acquaint the student with the basic components that make up a computer system and what each component contributes to the overall operation of such a system. The student will learn about the special codes in which data is represented inside computers as it is read in, stored, processed, and put out. The student learns what a data processing problem is, what constitutes a "solution" to such a problem and how to use certain special tools associated with solving data processing problems.
Prerequisite: Data Processing 221 and 222.

Data Processing 332: Computer Systems Fundamentals

In this course the student will learn how to use the computer as a tool for solving problems. The student will learn that the problem has to be analyzed and fed into the computer in a certain way before the computer can begin solving it. The student learns standard techniques and procedures for reducing data processing problems

to a form that the computer can handle.
Prerequisites: Data Processing 221 and 222.

Data Processing 333: Numbering Systems

In this course the student will learn how to use and work with the decimal base, binary base, octal base, and hexadecimal base. The student learns how to add, subtract, multiply, and divide in each base. Attention is given to negative balances and conversion factors.

Data Processing 421: PL/1 Computer Programming Part I

Included in this course is the use of IBM 360/75. The course is designed to acquaint the student with programming instruction, computer languages, writing a program, flow charting, paper tape, magnetic tape, and types of systems. The student learns the fundamentals of assignment statements, non-executable statements, input/output, array expressions, attributes, block structure, operators, character sets, and program definition.
Prerequisites: Data Processing 331 and 332.

Data Processing 422: PL/1 Computer Programming Part II

A continuation of Data Processing 421 with special attention given to more advanced business and mathematical problems; attention is given to advanced programming techniques in order to accomplish desired results. The student spends time in working with subroutines and decision tables. The student is assigned laboratory problems and one project.
Prerequisite: Data Processing 421

Data Processing 431: RPG Computer Programming Part I

This course is designed to help students to create programs in utilizing RPG language and to determine the extent to which RPG may be helpful in business installations. Upon successful completion of the course the student is able to:

1. Code specifications sheets.
2. Produce spacing chart of any output report and date or summary records to be generated.

3. Select the coding approach that will result in the fewest of generated program instructions.

4. Create the control cards required for the assembly and running of the RPG program.

Prerequisite: Data Processing 331 and 332.

Data Processing 432: RPG Computer Programming Part II

A continuation of Data Processing 431 with special attention given to more advanced business and mathematical problems. The student learns to work with zero suppression, decimal alignment and editing of a field. The student is assigned laboratory problems and one project.
Prerequisite: Data Processing 431.

College N

Business Education 125: Data Processing I

Data processing fundamentals, equipment, programming and systems, the basic data flow, machine-processable data and data organization as related to electronic equipment. A typical data processing installation is provided by the college for laboratory work.

Business Education 126: Data Processing II

This course orients the student in the basic principles of keypunching operation with emphasis on numeric punching, verifier, alphabetic punching and production punching. Additional equipment to be used includes sorters and collators.

College O

No courses offered

College P

Business Administration 352: Fundamentals of Data Processing

A presentation of the broad concepts of data processing and computer problems. Emphasis is placed upon the theory and philosophy of applica-

tion rather than on the mechanics of the various systems.

College Q

General Business 636-637: Fundamentals of Data Processing

An introduction of the broad concepts of data processing. Emphasis is placed upon the theory and mechanics of the various systems.

College R

Business Education 316: Data Processing

This course, which presents theory and machine operation, aims to develop basic understanding of the principles of processing data by automatic means; attempts to remove some of the mystery surrounding automation and to acquaint the student with the special language used in this field.

College S

No courses offered

College T

No courses offered

College U

No courses offered

College V

Data Processing 311: Introduction to Electronic Data Processing

A course providing a basic orientation to the field of electronic data processing as applied to business with emphasis on developing the basic techniques in the use of the unit records system for other disciplines leading to computer use, programming, and systems analysis.

Data Processing 312: Basic Wiring Principles

A course designed to give a background of general wiring methods and principles for punch-card machines and to teach basic operations and terms related to these machines and their functions.

Data Processing 314: Electronic Data Processing Machine Operation

A course designed to give detailed training for students who want to become machine operators and not be concerned with programming and wiring principles except those that are essential. Practical operating instructions and training in the operation of IBM 029 key punch, NCR 406, and IBM 407 accounting machine.
Prerequisite: typing 45 wpm.

Data Processing 315: Programming IBM 360/20

An introduction to programming and operating the IBM 360/20 system; development of the major concepts of computing and programming techniques needed for this system.
Prerequisite: EDP 311.

Data Processing 321: Computer Mathematics

This course provides the necessary foundation in numerical concepts for data processing and computer programming and relates the study of logic to contemporary computer languages. Topics included are the nature of the numbering systems, applications to numbering systems with other bases (relative to the computer), selected presentations of algebra iterative methods, matrix methods, linear programming and numerical methods, modern algebra, logic switching circuits. Boobar algebra and the study of sets as applied to the computer.
Prerequisites: EDP 311, Math 112, and 114.

Data Processing 322: Introduction to Programming

The objective of this course is to provide the student with the basic concepts of programming so that he may easily master any specific system with the minimum of additional instruction. The course will cover such topics as characteristics of digital computers, development of computer

languages, introduction to FORTRAN, COBOL, BASIC, and PL/1 programming.
Prerequisite: EDP 311.

College W

Business 260: Introduction to Electronic Data Processing

An introduction to the use of data processing equipment aimed at developing student skill in wiring and the operating aspects of data processing equipment to solve problems. Upon completion of the course, the student should be able to recognize the many different data processing machines and know how to operate them and do some limited programming.

Business 471: Electronic Data Processing in Business

A course in the application of electronic data processing to managerial decision problems in business. Emphasis is placed on description of computer hardware, flow charting, computer pro-programming problems and case studies.

Business 342: COBOL Programming

This course will cover the format and rules for using COBOL programming sheet; the formats of the four divisions (identification, environment, data, and procedures) and the most commonly used procedural words.
Prerequisite: Business 260.

College X

No courses offered

College Y

Education 517: Implications for Data Processing in Education

An intensive study of current attempts to apply new technologies to education. Attention will be given to research findings related to computer assisted instruction, gamed instructional simulation, approaches to guidance and pre-

scription learning as well as administrative problems pertaining to student scheduling, pupil reports, and data reporting systems.

College Z

Business 572: Electronic Data Processing for Business

Fundamentals of business data processing. The use of electronic computers and automatic machines in the areas of accounting, economics, management, marketing, and general business. The equipment and facilities of the Computer Science Center are utilized in the course.
Prerequisites: Math 224, Accounting 441 or 446, Accounting 444.

College A1

Business Administration 462: An Introduction to Automated Accounting Systems

A study of data processing principles and simulated use of these principles in modern business.
Prerequisite: Business Administration 321 (accounting course).

College A2

No courses offered

College A3

No courses offered

College A4

No courses offered

College A5

No courses offered

College A6

No courses offered

College A7

No courses offered

College A8

No courses offered

College A9

No courses offered

College A10

No courses offered

College A11

No courses offered

College A12

No courses offered

College A13

Business Administration 281: Computer Communications I

Computer programming in the FORTRAN IV language using the WATFOR compiler, emphasis on practical use of the computer in solving elementary numerical problems and games, basic JOB CONTROL language. Applicable for students in any area of concentration.

Business Administration 282: Computer Communications II

More advanced computer programming in either COBOL or PL/1 languages, emphasis on character

manipulation, data set organization, and retrieval and intermediate JOB CONTROL language.

College A14

No courses offered

College A18

Business 108: IBM Key Punch

Training on the IBM 026 key punch is designed to provide speed as well as thorough knowledge of key punch usage. It includes design and use of the IBM card as a source document for accounting applications, card punch functions and practice exercises which reinforces the student's knowledge.

Business 109: Basic Concepts of Data Processing

This course provides an understanding of the theory, principles, and technical aspects of automatic data processing, training in operating the basic IBM unit record machines and experience in wiring various machines.

College A17

Data Processing 3402: Automatic Data Processing I

Programming, wiring, and operation of punched card equipment. Card designing, key punching, sorting, tabulating, and preparation of reports. Application to problems in fields of accounting, economics, education, mathematics, psychology, and other research areas.

Data Processing 3412: Automatic Data Processing II

Advanced problems in the use of unit record equipment. Preparation of flow charts, procedure manual, and system design.

Data Processing 3422: Automation

A one quarter, survey course, introducing electronic computers with emphasis on stored

program concepts. Digital and analog computers and automated systems will be studied. Open to all students.

Data Processing 3202: Introduction to FORTRAN

A study of the elements of FORTRAN dialects, to include arithmetic expressions, assignment statements, conditional control and DO loops, input/output statements and format statements.
Prerequisites: Math 1411 or 1421 or 1513 or 2322.

Data Processing 3212: Introduction to PL/1

A study of the elements of the PL/1 language and its uses in business and scientific applications.
Prerequisites: Math 1411 or 1421 or 1513 or 2322.

Data Processing 3222: Introduction to COBOL

A study of the elements of the COBOL language and its use in business applications.
Prerequisites: Math 1411 or 1421 or 1513 or 2322.

Data Processing 4342: Advanced Problems in Data Processing I

Advanced programming in FORTRAN, SPS, and machine language involving calculus. Use of "canned" programs such as ERGEN flow routines, linear programming, simultaneous equation solvers. Numerical analysis.
Prerequisites: Data Processing 3202 and Math 2533.

Data Processing 4352: Advanced Problems in Data Processing II

Specialized problems involving the student's major descipline.
Prerequisite: approval of student's department of major study; submission of problems, and approval of data processing instructor regarding student's proficiency.

Data Processing 4362: Data Processing Systems Analysis

Integrated data processing systems. Relationship of the data processing installation with the operating definitions of the firm (includes both automatic and electronic data processing). The organizational position of data processing in the firm.
Prerequisite: Data Processing 3412.

Data Processing 5302: Automation

A one quarter survey course introducing the student to electronic computers with emphasis upon stored program concepts. Digital and analog computers and automated systems will be studied.

Data Processing 5352 (Education 5330): Data Processing for Educational Administrators

Basic concepts of programming automatic and electronic data processing equipment. Development of systems designs for the integrated processing of student records (registration and scheduling, grade and attendance reporting, test records, and permanent records). A study of the problems encountered in the installation and administration of a data processing center.

Data Processing 5362: Automatic Data Processing I

Programming and operation of punched card equipment. Data processing problems in fields of accounting, economics, education, mathematics, psychology, and other research areas.

Data Processing 5372: Automatic Data Processing II

Advanced problems and systems design with the use of unit record equipment. Preparation of flow charts, procedure manuals and integrated system design.
Prerequisite: Data Processing 5362.

APPENDIX B

COURSE OUTLINES

I. COURSE I

Title

Principles of Automatic Data Processing

Objectives

A. Understanding and appreciation of the historical development of automatic data processing.

B. Understanding the theory, principles,and technical aspects of automatic data processing and acquisition of skill in wiring the basic unit record machines.

C. Application and experience in operating the unit record machines and understanding of their uses in business.

D. Introduction to computers, systems analysis, and flowcharts.

For Whom Planned

The course is primarily planned for students majoring in Business Education and Secretarial Administration. It is appropriate, however, for any student interested in data processing.

Catalogue Description

Wiring and operation of unit record equipment. Card design, key punching, sorting, collating, and the

preparation of reports. Introduction to flowcharts, systems design, and computers. Not open to Freshmen.

Grade of Course

Grade III - third year undergraduate

Prerequisites

Consent of the instructor

Credit

Four semester hours. Three lectures and two one-hour laboratory periods weekly.

Course Outline

I. Introduction to data processing
   A. Historical background
   B. The punched card
      1. Card layout and design
      2. Card code

II. The recording of source information
   A. Operating features of IBM 24, 26, 29 machines
   B. Programming the key punch
      1. Alphabetic and numeric fields
      2. Field definition, skip, duplicate

III. Classification of information by sorting
   A. Operating features of the IBM 82 and 83 sorters
      1. Numeric sorting
      2. Alphabetic sorting

B. Special features of the IBM 83 sorter

IV. The preparation of reports

A. Operational features of accounting machines (types 402 and 403)

B. Control panel wiring

C. Carriage control

D. Multiple line printing, type 403 accounting machine

V. The collation of sorted data

A. Operational principle, IBM 85 and 87 collators

B. Principles of control panel wiring

C. Typical operations

VI. The reproduction of recorded information

A. Operational principles of IBM 513 and 514 reproducing punches

1. Reproducing

2. Gangpunching and verifying

3. Mark sensing

4. Summary punching

VII. Introduction to systems

A. System analysis

B. System flowcharts

VIII. Introduction to computers

A. Operational principles

B. Sample applications

Basic Texts and Important References

I. Basic Texts

Solomon, L. J. Machine operation and wiring. Belmont, California: Wadsworth Publishing Company, 1958.

Van Ness, R. G. Principles of punch card data processing. Elmhurst, Illinois: Business Press, 1959.

II. Important References

IBM Technical Reference Manuals:

A24-0520 - 024-026 card punch
A24-3332 - 029 card punch
A24-3333 - 059 card verifier
A24-1034 - 082-083 sorter
A24-5654 - 402-403 accounting machine
A24-1002 - 514 reproducing punch
A24-6384 - 548 interpreter
A24-1005 - 085 collator

II. COURSE II

Title

FORTRAN Programming

Objectives

A. To develop the student's ability to solve statistical and other mathematics-related problems through the use of a scientific language.

B. Upon completion of the course, the student will be able to code, compile, test, and debug simple FORTRAN IV problems to be run on the university computer center's equipment.

C. The student will also learn to use systematic techniques to solve a computer programming problem from definition, problem analysis, flowcharting, to documentation.

For Whom Planned

The course is intended primarily for sophomores and juniors majoring in science and mathematics.

Catalogue Description

Development of the FORTRAN language as a tool for solving scientific, statistical, and other mathematics-related problems on modern digital computers. The course will cover expressions in FORTRAN, algebraic

statements containing arithmetic functions and exponentiation, problem logic and input and output record description.

Grade of Course

Grade III - second and third year undergraduate students

Prerequisites

A basic knowledge of algebra

Credit

Three semester hours credit. Three hours lecture per week and one hour laboratory per week.

Course Outline

I. Introduction to digital computers
   A. Historical notes
   B. The digital computer
      1. Storage
      2. The stored program
      3. Addresses
      4. Control unit
      5. Arithmetic unit
      6. Binary arithmetic
      7. Input and output

II. The FORTRAN language
   A. Basic elements of the language

1. Constants
    a. Integer constants
    b. Real constants
2. Variables
    a. Variable names
    b. Variable types
    c. Naming variables
3. Arrays and subscripts
    a. Arrangement of arrays in storage
    b. Form of subscripts
    c. Subscripted variables
4. Expressions
    a. Arithmetic expressions
    b. Relational expressions
5. Statements
    a. A statement format

B. Arithmetic statements

C. Control statements
1. Unconditional GO TO statement
2. Computed GO TO statement
3. Relational IF statement
4. DO statement
5. CONTINUE statement
6. PAUSE statement
7. STOP statement
8. END statement

D. INPUT/OUTPUT statements

1. General I/O statements

a. FORMAT statement

b. Conversion of numeric data

c. Conversion of alphameric data

d. Carriage control

e. Data input to the object program

2. Manipulative I/O statements

a. BACKSPACE statement

b. REWIND statement

c. END FILE statement

E. Specification statements

1. Type statements (integer, real, external)

2. DIMENSION statement

3. COMMON statement

4. COMMON statement - with dimensions

5. EQUIVALENCE statement

6. COMMON with EQUIVALENCE statements

III. Selected exercises to be programmed in the FORTRAN Language*

A. Solution to simultaneous linear equations

B. Mean and standard deviation

C. Correlation

D. CHI square

E. Matrix operations - including inversion

F. Regression analysis

*This is a partial listing of exercises which will be programmed in the course. The primary emphasis in this course is on programming in the FORTRAN language rather than on specific applications.

Basic Texts and Important References

I. Basic Texts

IBM. FORTRAN IV language specifications, programming specifications, and operation procedures for IBM 1401, 1440, and 1460. Form number C24-3322-3. White Plains, New York: IBM, 1964.

Mullish, H. Modern programming: FORTRAN IV. Waltham Massachusetts: Blaisdell Publishing Company, 1968.

II. Important References

Canning, R. G. Electronic data processing for business and industry. New York: John Wiley and Sons, 1965.

Crowder, N. A. The arithmetic of computers. Garden City, New York: Doubleday, 1950.

Leeds, H. D., and Weinberg, G. M. Computer programming fundamentals. New York: McGraw-Hill, 1961.

McCracken, D. D. Digital computer programming. New York: John Wiley and Sons, 1957.

McCracken, D. D., Wise, H., and Lee T. H. Programming business computers. New York: John Wiley and Sons, 1959.

McCracken D. D. A guide to FORTRAN programming. New York: John Wiley and Sons, 1961.

Stibitz, G. R. and Larrivee, J. A. Mathematics and computers. New York: McGraw-Hill, 1957.

IBM Technical Reference Manuals:

A22-6810-8 - S/360 system summary
C28-6515-1 - S/360 FORTRAN language
J24-1455-1 - 1401 FORTRAN specifications

III. COURSE III

Title

Electronic Data Processing I

Objectives

A. To describe the developments in calculating machines which led up to the introduction of modern computers and diagram of the functional organization of a computer.

B. Explain how a basic computer program works and describe the major design objectives of at least three programming languages.

C. Understand data processing terminology which will enable the student to carry on meaningful discussions with the data processing people.

For Whom Planned

This course is primarily intended for advanced undergraduate and graduate students.

Catalogue Description

An introduction to the major concepts and characteristics of data processing. The development of elements in the programming of the IBM System/360 and RCA SPECTRA 70 computers.

Grade of Course

Grade V - advanced undergraduate and graduate students

Prerequisites

Consent of the instructor

Credit

Three semester hours. Three lectures per week.

Course Outline

I. History
   A. The history of calculating machines
   B. The development of electronic computers
II. The computer industry
   A. Manufacturers
   B. Positions in the field
III. Programming
   A. The aspects of programming
   B. The aspects of coding
   C. Work and tools of the systems analyst
   D. FORTRAN, COBOL, and other programming languages
   E. Software systems
   F. Specifying and documenting computer programs
IV. Hardware
   A. Unit record input/output devices

B. How computers operate

C. Magnetic input/output devices

V. Data processing

A. Business data processing

B. Scientific data processing

C. Files and records

D. Sorts and merges

VI. Computer Systems

A. Centers and how they operate

B. Teleprocessing and real-time computing

C. Multiprogramming

D. Time sharing

Basic Texts and Important References

I. Basic Text

Davis, G. B. Computer data processing. New York: McGraw-Hill, 1969.

II. Important References

Awad, E. M., and Data Processing Management Association. Automatic data processing. Englewood Cliffs, New Jersey: Prentice-Hall, 1966.

Bates, F., and Douglas, M. L. Programming language/one. Englewood Cliffs, New Jersey: Prentice-Hall, 1967.

Bore, W. F., and Murphy, J. R. The computer sampler: Management perspectives on the computer. New York: McGraw-Hill, 1968.

Davis, G. B. An introduction to electronic computers. New York: McGraw-Hill, 1965.

Farina, M. V. COBOL simplified. Englewood Cliffs, New Jersey: Prentice-Hall, 1968.

Germain, C. B. Programming the IBM 360. Englewood Cliffs, New Jersey: Prentice-Hall, 1967.

Levy, J. Punched card data processing. New York: McGraw-Hill, 1967.

McCameron, F. A. COBOL logic and programming. Homewood, Illinois: Richard D. Irwin, 1966.

Rosen, S. (Ed.) Programming systems and language. New York: McGraw-Hill, 1967.

Sanders, D. H. Computers in business: An introduction. New York: McGraw-Hill, 1968.

Schoderbek, P. P. (Ed) Management systems. New York: John Wiley and Sons, 1967.

Wegner, P. Programming languages, information structures, and machine organization. New York:: McGraw-Hill, 1968.

IV. COURSE IV

Title

Electronic Data Processing II

Objectives

A. To present the following using the facilities of the IBM S/360 or RCA SPECTRA 70 Assembler Language: data definition, manipulation, and conversion.

B. To introduce the student to program branching and control, editing, indexing and table-lookup procedures.

C. To present code conversion, subroutine, and subroutine linkage.

For Whom Planned

The course is intended primarily for advanced undergraduate and graduate students.

Catalogue Description

Introduction to Basic Assembler Languages for the IBM S/360 and RCA SPECTRA 70 computers. Instructions and capabilities of the language are covered in detail.

Grade of Course

Grade V - advanced undergraduate and graduate students

Prerequisites

Consent of instructor and Electronic Data Processing I

Credit

Three semester hours. Three lectures per week and informal laboratory periods.

Course Outline

I. Introduction to the assembler language
   A. The assembler language
      1. Machine operation codes
      2. Assembler operation codes
      3. Macro instructions
   B. Assembler language coding conventions
   C. Assembler language structure
   D. Terms
      1. Symbols
      2. Self-defining terms
      3. Location counter reference
      4. Literals
   E. Expressions
   F. Addressing - program sectioning and linking
      1. Addressing
      2. Program sectioning and linking

II. Machine Instructions

A. Machine instruction mnemonic codes

B. Extended mnemonic codes

III. Assembler instruction statements

A. Symbol definition instruction

B. Data definition instructions

C. Listing control instructions

D. Program control instructions

E. Conditional assembly and macro facilities in the assembler language

F. Introduction to the conditional assembly and macro facilities

G. How to prepare macro definitions

H. How to write macro instructions

Basic Texts and Important References

I. Basic Texts

Computer Usage Company. Programming the IBM system/360. New York: John Wiley and Sons, 1966.

II. Important References

Chapin, N. 360 programming in assembly language. New York: McGraw-Hill, 1968.

Germain, B. Programming the IBM 360. Englewood Cliffs, New Jersey: Prentice-Hall, 1967.

Martin, J. Programming real time computer systems. Englewood Cliffs, New Jersey: Prentice-Hall, 1965.

Walnut, F. K. Introduction to computer programming and coding. Englewood Cliffs, New Jersey: Prentice-Hall, 1968.

Wegner, P. Programming languages, information structures and machine organization. New York: McGraw-Hill, 1968.

IBM Technical Reference Manuals:

A22-6821 - S/360 principles of operation
C24-3427 - S/360 disk operating system; data management concepts
C24-3430 - S/360 tape operating system; data management concepts
C24-5037 - S/360 disk operating system: supervisor and input/output macros
C24-5035 - S/360 tape operating system: supervisor and input/output macros
C24-5036 - S/360 disk operating system: system control and system service programs
C24-5034 - S/360 tape operating system: system control and system service programs
C24-5033 - S/360 disk operating system: system generation and maintenance
C24-5043 - S/360 disk and tape operating systems: utility macro specifications
C24-5015 - S/360 tape operating system: system generation and maintenance

V. COURSE V

Title

COBOL Programming

Objectives

A. To develop the student's ability to solve business related problems with the use of digital computer techniques.

B. Upon completion of the course, the student will be able to code, compile, test, and debug simple COBOL problems to be run on the university computer center's equipment.

For Whom Planned

The course is intended primarily for juniors and seniors in the School of Business and for graduate students with approval of advisor.

Catalog Description

Development of the COBOL language as a tool for solving business related problems on digital computers. Systematic techniques for conversion of business problems: problem analysis, flowcharting, and programming.

Grade of Course

Grade V - advanced undergraduate and graduate students

Prerequisites

Electronic Data Processing I or approval of instructor

Credit

Three semester hours. Three lectures per week and informal laboratory periods.

Course Outline

I. Introduction to COBOL
   A. History
   B. COBOL general
   C. COBOL for S/360
II. COBOL program structure
   A. The COBOL language
      1. Divisions
      2. Sections
      3. Paragraphs
      4. Entries
   B. Elements
      1. Programmer supplied names
      2. Reserved words
      3. Literals
         a. Numeric
         b. Non-numeric
      4. Level numbers
      5. Pictures

C. Character sets

1. Punctuation

2. Notation

D. Identification division

1. FORMAT

2. Function

E. Environmental division

1. FORMAT

2. Function

F. Data division

1. The file section

2. Record description entries

3. The working-storage section

G. Procedural divisions

1. INPUT/OUTPUT statements

2. The GO TO and STOP statements

3. The MOVE statement

4. Arithmetic operations

5. Program switches

6. IF statement

7. PERFORM statement

III. Sample workshop problems

A. Inventory update

B. Report card

C. Accounts receivable

D. Capital equipment depreciation

Basic Texts and Important References

I. Basic Texts

Bernard S. M. System/360 COBOL. Englewood Cliffs, New Jersey: Prentice-Hall, 1965.

IBM. COBOL general information manual. Form number F28-80-53-2. White Plains, New York: IBM.

II. Important References

Farina, M. V. COBOL simplified. Englewood Cliffs, New Jersey: Prentice-Hall, 1968.

Germain, C. B. Programming the IBM 360. Englewood Cliffs, New Jersey: Prentice-Hall, 1967.

Golden, J., and Leichus, R. M. IBM 360 programming and computing. Englewood Cliffs, New Jersey: Prentice-Hall, 1967.

Raun, D. L. An introduction to COBOL--Computer programming for accounting and business analysis. Belmont, California: Dickenson Publishing Company, 1966.

Sammet, J. Programming languages: History and fundamentals. Englewood Cliffs, New Jersey: Prentice-Hall, 1969.

IBM Technical Reference Manuals:

C24-3233-3 - S/360 disk and tape operating system; COBOL language specifications
C24-5025-4 - S/360 disk and tape operation systems: COBOL programmers guide
C28-6394-0 - S/360 disk operating system; USA standard COBOL

VI. COURSE VI

Title

Systems Design and Analysis

Objectives

A. Enable the student to develop a systems solution that includes documentation of input, output, data flow and a general description of runs and logic.

B. Develop the student's ability to consider programming systems options and equipment usage.

For Whom Planned

The course is primarily for seniors and graduate students majoring in Business Administration and Educational Administration.

Catalogue Description

Development of systems solutions to develop the digital computer as a tool in business related problems.

Grade of Course

Grade V - advanced undergraduate and graduate students

Prerequisites

Course in programming digital computers using the COBOL or FORTRAN languages

Credit

Three semester hours. Three lectures per week.

Course Outline

I. Development and use of documentation techniques
   A. Documentation forms
      1. Use of forms
      2. Improvements and refinements
II. Understanding an existing system
   A. Documenting a survey
      1. Forms and their relationships
      2. Levels of detail
   B. A non-mechanized system
      1. Resource usage sheets
      2. Activity sheet
      3. Operations sheet
      4. Message sheet
      5. File sheet
III. Determining systems requirements
   A. Analysis of requirements
      1. Need for requirements
      2. Sources of information
      3. Determinates
      4. Documentation forms
      5. Use of forms
   B. Determining requirements in a non-mechanized system

1. INPUT/OUTPUT sheets
2. Required operations sheets
3. Resources sheets
4. Supporting documentation

C. Determining requirements in a mechanized system
1. INPUT/OUTPUT sheets
2. Required operations sheets
3. Resources sheets

D. Developing systems requirements
1. Approximations
2. Operational dependence
3. Developing decision

IV. Describing the new system

A. Systems design
1. Sources of information
2. Successive approximations

B. Communicating details of the new system
1. Need for communication
2. Documentation forms

C. Describing the projected system
1. Plan for systems documentation

V. Programming the new system

A. Method of work
1. Programmer's check list
2. Languages
3. Program flowchart

4. Machine generated flowcharts

5. Program structure

B. General programming rules

1. Editing and validation

2. Error codes

3. Aids to operation

4. Programming

5. Prologue information

C. System/360 programming rules

Basic Texts and Important References

I. Basic Texts

Boutell, W. S. Computer-oriented business systems. Englewood Cliffs, New Jersey: Prentice-Hall, 1968.

IBM Technical Reference Manuals:

F20-8150 - basic systems study guide
F20-8047 - advanced analysis method

II. Important References

Anton, H. R., and Boutell, W. S. FORTRAN and business data processing. New York: McGraw-Hill, 1968.

Forrester, J. W. Industrial dynamics. New York: John Wiley and Sons, 1961.

Gregory, R. H., and Van Horn, R. L. Automatic data processing systems, principles and procedures. Belmont, California: Wadsworth Publishing Company, 1960.

Gregory, R. H., and Van Horn, R. L. Automatic data processing systems, principles and procedures. (2nd ed.) Belmont, California: Wadsworth Publishing Company, 1963.

Handley, G., and Whitin, T. M. Analysis of inventory systems. Englewood Cliffs, New Jersey: Prentice-Hall, 1963.

IBM Technical Reference Manuals:

F28-8053-1 - COBOL general information manual
C28-6571-0 - S/360 PL/1 language specifications

VII. COURSE VII

Title

Application of Digital Computers as an Instrument for Research

Objectives

A. To introduce the student to mathematical calculations using the FORTRAN IV language.

B. Formulate problem solutions using interactive programming techniques.

C. Heavy emphasis will be placed on developing the student's abiltiy to use library programs and systems such as IBM GPSS, UCLA statistical programming system, etc.

For Whom Planned

The course is intended primarily for advanced undergraduate students and graduate students in behavioral science, education, science, and business.

Catalogue Description

Formulation of numerical problems in the FORTRAN IV language for solution on digital computers related to business, science, education, and the bahavioral sciences. Implementation of statistical applications requiring the integration of data processing and analytical programming techniques.

Grade of Course

Grade V - advanced undergraduate and graduate students

Prerequisites

Electronic Data Processing I and basic knowledge of algebra and statistics or consent of instructor.

Credit

Three semester hours credit. Three hours lecture per week and one hour laboratory period per week.

Course Outline

I. Introduce key punch

II. Introduce control systems

A. TUCC (Triangle Universities Computing Center)

1. WATFOR

2. FORTRAN

B. IBM S/360

C. RCA SPECTRA 70

III. Introduction to FORTRAN IV

A. Features of the language

1. FORTRAN IV for the S/360

2. FORTRAN IV subsets

3. FORTRAN IV for RCA SPECTRA 70

4. FORTRAN IV for TUCC

B. Punched card input, arithmetic operations, standard functions, printed output

1. Arithmetic statements
2. READ and PRINT statements
3. IF, Unconditional GO TO, and STOP statements
4. Additional examples

C. Definition of functions, manipulation of single-subscripted variables, magnetic tape input and output

1. Integer constants and variables
2. DIMENSION statements
3. DO statements
4. Function statements
5. The meaning of a list
6. FORMAT statements
7. Magnetic tape input and output
   a. READ INPUT TAPE and WRITE OUTPUT TAPE statements
   b. General information about the use of tapes

D. Manipulation of two- and three-dimensional arrays

1. Subscripts for two- and three-dimensional arrays
2. DO nests
3. Lists for two- and three-dimensional arrays
4. Assigned GO TO statements
5. Computed GO TO statements
6. FORMAT statements

a. Scale factors

b. Hollerith fields

c. Multiple-line format

7. Debugging

8. Storage

IV. Selected exercises to be programmed in the FORTRAN language

A. Mean, variance, and standard deviation

B. Linear regression and correlation

C. Spearman rank correlation

D. Kendall rank correlation

E. Biserial coefficient of correlation

Basic Texts and Important References

I. Basic Tests

Golden, J. T. FORTRAN IV: Programming and computing. Englewood Cliffs, New Jersey: Prentice-Hall, 1968.

IBM Technical Reference Manuals:

A22-6810-8 - S/360 system summary
C28-6515-1 - S/360 FORTRAN language

II. Important References

Borko, H. Computer applications in the behavioral sciences. Englewood Cliffs, New Jersey: Prentice-Hall, 1962.

Canning, R. G. Electronic data processing for business and industry. New York: John Wiley and Sons, 1956.

Crowder, N. A. The arithmetic of computers. Garden City, New York: Doubleday, 1950.

Dimitry, D., and Mott, T. Introduction to FORTRAN IV programming. New York: Holt, Rinehart, and Winston, 1966.

Leeds, H. D., and Weinberg, G. M. Computer programming fundamentals. New York: McGraw-Hill, 1961.

McCracken, D. D. Digital computer programming. New York: John Wiley and Sons, 1957.

McCracken, D. D., Wise, H., and Lee T. H. Programming business computers. New York: John Wiley and Sons, 1959.

McCracken, D. D. A guide to FORTRAN programming. New York: John Wiley and Sons, 1961.

Stibitz, G. R., and Larrivee, J. A. Mathematics and computers. New York: McGraw-Hill, 1957.

VIII. COURSE VIII

Title

Automatic Data Processing for Business Teachers

Objectives

A. Understanding the theory, principles, and technical aspects of automatic data processing and acquisition of skill in wiring the basic unit record machines.

B. Application and experience in operating the unit record machines and understanding their uses in business.

C. Introduction to systems analysis and flowcharts.

D. Emphasize teaching problems and procedures.

For Whom Planned

The course is planned to prepare business teachers to provide an instructional program in automatic data processing in high schools, technical institutes, and community colleges.

Catalogue Description

Wiring and operation of unit record equipment. Card design, key punching, sorting, collating, and the preparation of reports. Introduction to flowcharts and systems design. Attention to problems and procedures in teaching.

Grade of Course

Grade VI - graduate students

Prerequisites

Graduate status

Credit

Four semester hours credit. Three lectures per week and two one-hour laboratory periods per week.

Course Outline

I. Introduction to data processing
   A. Historical background
   B. The punched card
      1. Card layout and design
      2. Card code
   C. Teaching problems and procedures
II. The recording of source information
   A. Operating features of IBM 24, 26, 29 machines
   B. Programming the key punch
      1. Alphabetic and numeric fields
      2. Field definition, skip, duplicate
   C. Teaching problems and procedures
III. Classification of information by sorting
   A. Operating features of the IBM 82 and 83 sorters
      1. Numeric sorting
      2. Alphabetic sorting

B. Special features of the IBM 83 sorter

C. Teaching problems and procedures

IV. The preparation of reports

A. Operational features of accounting machines, types 402 and 403

B. Control panel wiring

C. Carriage control

D. Multiple line printing, type 403 accounting machine

E. Teaching problems and procedures

V. The collation of sorted data

A. Operational principles, IBM 85 and 87 collators

B. Principles of control panel wiring

C. Typical operations

D. Teaching problems and procedures

VI. The reproduction of recorded information

A. Operational principles, IBM 513 and 514 reproducing punches

1. Reproducing

2. Gangpunching and verifying

3. Mark sensing

4. Summary punching

B. Operating principles of the IBM 548 Interpreter

C. Teaching problems and procedures

VII. Introduction to systems

A. System analysis

B. System flowcharts

Basic Texts and Important References

I. Basic Texts

Solomon, L. J. Machine operation and wiring. Belmont, California: Wadsworth Publishing Company, 1958.

Van Ness, R. G. Principles of punch card data processing. Elmhurst, Illinois: Business Press, 1959.

II. Important References

IBM Technical Reference Manuals:

A24-0520 - 024-026 card punch
A24-3332 - 029 card punch
A24-3333 - 059 card verifier
A24-1034 - 082-083 sorter
A24-5654 - 402-403 accounting machine
A24-1002 - 514 reproducing punch
A24-6384 - 548 interpreter
A24-1005 - 085 collator

Writer's Name Emily D. Gloster

Cluster Boone, North Carolina

I certify that I have read this practicum report and have discussed its contents with the writer.

7-22-74 (Date)

Nancy R. Moore (signature of peer reader)

I certify that I have read this practicum report and have discussed its contents with the writer.

July 22, 1974 (Date)

Wilbur M. Deal (signature of peer reader)

I certify that I have read this practicum report and have discussed its contents with the writer.

July 22, 1974 (Date)

Richard Daniel (signature of peer reader)

.....

I certify that I have read this practicum report and that in my opinion it conforms to acceptable standards for practicums in the Doctor of Education Program.

(Date)

(signature of Practicum Director)

A CURRICULUM STUDY IN DATA PROCESSING

CURRICULUM AND INSTRUCTION

by

Emily D. Gloster, M. S.

Appalachian State University

DR. LELAND COOPER

A PRACTICUM PROPOSAL PRESENTED TO NOVA UNIVERSITY
IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE
DEGREE OF DOCTOR OF EDUCATION

NOVA UNIVERSITY

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CHAPTER I

INTRODUCTION

I. BACKGROUND

Much material has been wirtten in the past two decades about data processing, "magic brains," and a second Industrial Revolution. Many people fear automation because of its impact on the business environment and the mysterious terminology used by data processing personnel. However, "in its simplest definition, data processing is nothing but the handling of information. Automation is simply the use of mechanical devices to accomplish a job (Wood and Espegren, 1964 p. 15)."

Data processing has been going on ever since "the first caveman learned to count on his stubby fingers (Wood and Espegren, 1964, p. 15)."

Merchants on the Nile River dictated business transactions to their scribes who wrote the information on clay tablets with sharpened sticks. The invention of paper by the Egyptians accelerated the evolution of data processing; and in Italy 400 years ago, the double-entry system of bookkeeping was created which gave rise to modern-day accounting systems.

It was not until the 1940's however, that "automation" in its true sense emerged. The Mark I, designed by Professor Howard Aiken of Harvard University and built with the assistance of the International Business Machines Corporation in 1944, was the first successful working modern-day computer. The ENIVAC was built and completed at the University of Pennsylvania in 1946. These early vacuum-tube computers were

primarily designed and built by mathematicians and statisticians for their use in solving complicated mathematical formulas and equations.

The use of the computer has spread today into practically all phases of man's work. For example, in the area of business, the computer is used for inventory control, personnel records, and as an aid in management decisions to mention only a few. In the field of medicine, the computer is being used to aid the diagnostician, to monitor the vital signs of patients, and in medical research. In education, the computer is being used for pupil population projections, school scheduling, pupil personnel records, and in administrative decision-making. The computer is also being used as a research tool in the areas of agriculture, psychology, sociology, and economics.

II. STATEMENT OF THE PROBLEM

The widespread use of the computer has placed a responsibility on education to supply teachers, instructors, and professors who can teach and train students in the area of data processing and to develop courses which will meet the students's aims and objectives.

It will be the purpose of this study to:

1. develop a curriculum to train teachers to teach the various facets of data processing on the high school, vocational-technical institute, or community college level.

2. develop courses which meet the needs of undergraduate and graduate students in the fields of business adminstration, education, psychology, sociology, and the sciences at Appalachian State University, Boone, North Carolina.

III. IMPORTANCE OF THE STUDY

GENERAL

With the inevitable impact of data processing on office occupations alone, there is no question that educational institutions must realize their responsibility and challenge to prepare young people to compete for jobs.

Dr. F. Kendrick Bangs found in a national survey conducted in 1968 that about 19 per cent of the high schools and 61 per cent of the junior colleges and vocational schools were offering work in data processing or were planning to offer it. He found that schools are not meeting the needs in training personnel for job opportunities in data processing and that much more effort is needed to inaugurate curriculums in data processing and to update the programs currently in existence (Bangs and Hillestad, 1968).

"Part of this confusion is caused by the fact that data processing is far more than 'just another course' to be squeezed into an already crowded curriculum (Bangs and Hillestad, 1968, pp. 12, 20)." High schools are perplexed with a dual responsibility: to the college-bound student who must meet academic requirements, and to the vocationally oriented student who must be prepared to compete in the new technological business environment.

Today, organizations are confronted with keen competition in the recruitment and retention of electronic data processing personnel. Dick H. Brandon (1966), of Brandon Applied Systems, Incorporated, states that

> . . . because the (electronic data processing) field is growing, because there is a shortage of qualified people to man data processing installations, and because employers

> vant those they want now, there is a real scramble for available talent (p. 24) . . .

Brandon (1966) contends that by 1970 both the quantity of operational electronic computers and the related data processing personnel requirements will increase by nearly 100 per cent.

Fred R. Raach (1966), Vice President and General Manager of the Data Processing Division of the UNIVAC Division of Sperry Rand Corporation, related different employment needs when he stated that the

> . . . requirements for manpower in 1970 are estimated to be three times the 150,000 analysts, programmers, and operating personnel in data processing today. . . . Despite the saving in manpower through technological changes eliminating some routine programming, the shortage in needs for programmers is expected to be acute over the next few years (p. 24).

Addressing the American Management Association, David B. Hertz (1966), a director of the McKinsey and Company management consultant firm, predicted that the 1970 deficit of computer personnel probably will reach the "famine" stage. As a result, ". . . the competition for talented people is going to be fierce (p. 6). . ."

BACKGROUND OF APPALACHIAN STATE UNIVERSITY

The first men who came to the mountain frontier of Northwestern North Carolina found the going rough. A diary kept during the first known expedition into the area stated: "Part of the way we had to crawl on hands and feet; sometimes we had to take the baggage and saddles off the horses and drag them up the mountain, for the horses were in danger of falling backwards--as we had once an experience and sometimes we had to pull the horses up while they trembled and quivered like leaves."

When the first explorers reached the summitt of the Blue Ridge Mountains, where a twig placed in a certain bubbling, cold, clear stream

would drift either toward the Atlantic or the Mississippi, the explorers stood and marveled at the "hundreds of mountain peaks all around," which presented a "spectacle like ocean waves in a storm."

The area was first settled by English-speaking hunters. The first dwelling in Boone was a hunting cabin of a man named Benjamin Howard. That goes back to 1769. The cabin stood on what is now Appalachian State University. Daniel Boone used the cabin as a base for some eight years before he finally crossed the "great Appalachian barrier" and pushed on westward in Tennessee and Kentucky.

Benjamin Howard sided with the British during the Revolution, and he hid during the Revolutionary times from the patriots on a high knob above what was to become Boone (the knob became Howard's Knob). Howard later made peace with the patriots. The settlers who came after the Revolution were English, Scotch-Irish, and German. As the frontier moved forever westward, many crossed over the mountains.

Some stayed. They kept the proud, resourceful, rugged ways needed to survive in the beautiful, yet often hostile environment. The area was known as "the Lost Provinces," and for good reason. None but the very determined could make it up where the high meadows lay against the sky. The railroad came in 1899 and truly good roads were not built until the 1940's.

For a long time in the area, formal education was carried out, weather permitting, after the fall crops were in until it was time to plow. Education was, at best, minimal. In 1899, a two-story frame structure was built in Boone, a town of 200 persons. The people of the

local community contributed labor, materials and $1,100 to start a school--known as Watauga Academy. It offered instruction in grades one through 11 and in teacher training. Three courses were offered: Common School, Academic, and Two Years' Collegiate.

An institute always was held during the summer for teachers. Pupils received instruction on how to teach, thus making their work more enjoyable to them and more beneficial to the students, and they would be taught and coached in the very subjects upon which they would have to take an examination to renew their certificates or to raise them to the highest grade--The First Grade Certificate.

Watauga Academy grew steadily, In the winter of 1902 more than 100 pupils were enrolled, and 90 percent of those were grown people.

Despite all the progress made, Watauga Academy "rested upon a precarious and almost starvation financial foundation." The founders of the academy, the Dougherty brothers, D. D. and B. B., realized that without adequate financial support the academy would never be able to train enough teachers needed in the area. They turned to the state for help.

On a cold January morning in 1903, with a temperature of eight degrees, B. B. Dougherty started out for Lenoir on the family horse, and then continued by train for the capital city of Raleigh. In his pocket he carried a bill proposing a state institution for Northwestern North Carolina.

Dougherty encountered initial opposition for his proposal. The plight of the extreme northwestern edge of the state was not appreciated by some of the leaders of the day. Undaunted, Dougherty sought an appeal before Governor Charles B. Aycock, known as "the Education Governor."

In the privacy of the Governor's office, Dougherty pointed out that the "Education Governor" could ill afford to oppose a bill that promised so much for the teacher. He reminded the Governor that he had boasted the building of a new schoolhouse every time the sun set since being elected and that certainly there was no need for a schoolhouse without a place to train a teacher.

Aycock pledged his support, and Dougherty appeared before the House Committee on Education. Dougherty told the committee that the legislature had helped other sections of the state and it should help Northwestern North Carolina. He asked for only small appropriations, as the local people were willing to match state funds dollar-for-dollar.

Among the reasons given why teachers in Northwestern North Carolina could not attend the schools already established, Dougherty said, was that the salary of the teachers in the mountains was too low to allow them to attend a school where expenses were high; mountain people could not endure a summer in the heat of the flatlands; and the university professor would take little interest in the unsophisticated country teacher.

The bill was introduced into the House by the Honorable W. C. Newland of Lenoir. Joining with Newland was the Honorable R. [illegible] Doughton who brought with him the prestige of his unexcelled reputation for wise statesmanship. Support also was given by senators from Cleveland, Franklin, and McDowell counties. The enabling bill passed by one vote more than needed for the two-thirds majority. Just before the measure came up, however, Mr. Newland suddenly notified two senators that they had other pressing "engagements." How they would have voted had they been present is not recorded.

In chartering a training school for teachers, the state pledged $2,000 annually for maintenance and $1,500 to be appropriated for buildings when a like amount was paid by private contributions. Tuition was to be free to those who pledged themselves to teach in the public schools of the state for two years.

The Doughertys won a major political and educational victory for the mountain region when, by a one-vote margin, the 1903 General Assembly created Appalachian Training School. Its just-appointed trustees met in Blowing Rock three months after the vote and heard representatives of several mountain counties and towns who spoke in behalf of locating the institution in their area. According to the minutes of the board, Boone offered the facilities of the academy as a home for the state school, and it was declared to be Appalachian's permanent location.

The board elected B. B. Dougherty as superintendent of the school, and his brother was named principal. They served under those titles and guided the school as it grew with the state system until 1921 when Superintendent Dougherty was named President, and Principal Dougherty was named Treasurer and Business Manager.

The Assembly changed the name of the institution to Appalachian State Normal School in 1925. In 1929 it became Appalachian State Teachers College. The enabling act which changed the name of the institution also authorized the conferring of college degrees.

Modest graduate programs began at the college in 1943, and in 1949 Appalachian's graduate school was sanctioned by the American Association of Colleges for Teacher Education.

It was not until 1957 that legislation was enacted to give Appalachian permission to depart from its single-purpose role as a teacher-training institution. In 1965 the institution activated programs that led to nonteaching degrees.

The next milestone in the evolution of the institution came in 1967 when Appalachian was designated a regional university. Its purpose was set forth by the 1969 General Assembly as follows:

The regional universities shall provide undergraduate and graduate instruction in the liberal arts, fine arts, and sciences, and in the learned professions, including teaching, these being defined as those professions which rest upon advanced knowledge in the liberal arts and sciences, pure and applied. The regional universities shall provide other undergraduate and graduate programs of instruction as are deemed necessary to meet the needs of their constituencies and of the State. Regional universities insofar as possible shall extend their educational activities to all persons of the State who are unable to avail themselves of their advantages as resident students by means of extension courses, by lectures, and by such other means and methods as may seem to the boards of trustees and administrative officers as most effective.

In 1971, the structure of higher education in North Carolina was consolidated into a 16-member University of North Carolina system, efforts for which Appalachian supported.

The University of North Carolina was chartered in 1789 and opened its doors to students in 1795. It has been governed by a Board of Trustees chosen by the legislature and presided over by the Governor. During the

period 1917-1972, the Board consisted of 100 elected members and varying number of ex officio members.

By act of the General Assembly of 1931, without change of name, it was merged with The North Carolina College for Women at Greensboro and The North Carolina College of Agriculture and Engineering at Raleigh to form a multicampus institution designated The University of North Carolina.

In 1963 the General Assembly changed the name of the campus at Chapel Hill to The University of North Carolina at Chapel Hill and that at Greensboro to The University of North Carolina a Greensboro and, in 1965, the name of the campus at Raleigh to North Carolina State University at Raleigh.

Charlotte College was added as The University of North Carolina at Charlotte in 1965, and, in 1969, Asheville-Biltmore College and Wilmington College became The University of North Carolina at Asheville and The University of North Carolina at Wilmington, respectively.

A revision of the North Carolina State Constitution adopted in November, 1970 included the following: "The General Assembly shall maintain a public system of higher education, comprising The University of North Carolina and such other institutions of higher education as the General Assembly may deem wise. The General Assembly shall provide for the selection of trustees of The University North Carolina. . ." In slightly different language, this provision had been in the Constitution since 1868.

On October 30, 1971, the General Assembly in special session merged, without changing their names, the other ten state-supported senior institutions into the University as follows: Appalachian State University, East

Carolina University, Elizabeth City State University, Fayetteville State University, North Carolina Agricultural and Technical State University, North Carolina Central University, North Carolina School of the Arts, Pembroke State University, Western Carolina University, and Winston-Salem State University. This merger became effective on July 1, 1972.

The Board of Trustees became the Board of Governors and the number was reduced to 35 members (32 after July 1, 1973) elected by the General Assembly.. It is "responsible for the general determination, control, supervision, management, and governance of all afairs of the constituent institutions." However, each constituent institution has a local board of trustees of 13 members, eight of whom are appointed by the Board of Governors, four by the Governor, and one, the elected president of the student body, whose principal powers are exercised under a delegation from the Board of Governors.

Each institution has its own faculty and student body, and each is headed by a chancellor as its chief administrative officer. Unified general policy and appropriate allocation of function are effected by the Board of Governors and by the President with other administrative officers of the University. The General Administration office is located in Chapel Hill.

The chancellors of the constituent institutions are responsible to the President as the chief administrative and executive officer of The University of North Carolina.

Within the framework of higher education established by the state of North Carolina, Appalachian State University is dedicated to the total

development of its constituency through instruction, research, and service.

In pursuit of this purpose, Appalachian pledges itself:

To nurture an intellectual climate in which truth is sought and respected.

To provide a liberal education for all its students.

To offer, within the scope of its programs, preprofessional and professional education to those students who desire it.

To maintain a faculty dedicated to teaching and scholarship.

To advance the frontiers of knowledge through research.

To be cognizant of new knowledge and prepared to meet the challenge of new ideas.

To expand cultural horizons and develop appreciation of ethical and aesthetic values.

To make its resources available to the people within its sphere of influence.

To serve as a force for social improvement.

To cooperate with all institutions and agencies which are dedicated to the betterment of mankind.

IV. LIMITATIONS

The following limitations are foreseen:

1. The curriuclum in this study is to be developed at the request of the Chancellor of Appalachian State University.

2. This curriculum will be limited to training those persons who have obtained their four-year degree and to those who are in the process of earning this degree

3. This curriculum in its present form will not lead to a major in computer science at the University as a major program in this area has

not yet been granted by the General Assembly of the University of North Carolina system. This curriculum, however, would form the base to then be expanded to a degree program.

4. This study will be limited to the upgrading or retraining of teachers already in the teaching field or those about to enter it. This curriculum is to teach them about data processing and to enable them to then teach data processing to their students.

5. This study will be limited to supplying graduate and undergraduate students a research tool to be used in their studies and to give them general purpose knowledge about data processing.

V. DEFINITION OF TERMS

The following terms and their definitions will be used in the study:

FORTRAN (Formula Translation). An automatic coding system designed to simplify the programming of scientific and engineering problems. The FORTRAN language closely parallels the language of mathematics.

COBOL (Common Business Oriented Language). An automatic coding system designed to simplify the programming of problems commercial in nature.

Machine Language. Information recorded in a form that a computer may use without prior translation.

Key Punch. A key punch machine transfers information from coding sheets to cards and prints on the card the information punched into the card.

Verifier. A verifier checks the accuracy of key punching by "re-doing" the key punching process.

IBM. IBM is the accepted abbreviation for the International Business Machines Corporation. Throughout the study this abbreviation will be used.

S/360. S/360 is the accepted abbreviation for the IBM System/360 Computing System. Throughout the study this abbreviation will be used.

PL/1. An automatic coding system designed to simplify programming of problems on the S/360.

Accounting Machine. A unit record machine that reads punched cards and produces output in the form of a printed report.

Sorter. A unit record machine that arranges cards in proper numerical or alphabetical sequence; this sequence may be ascending or descending.

Collator. A unit record machine that interfiles two sets of cards in sequence.

Reproducer. A unit record machine that can duplicate on a new card, in the same or different position, all or part of the data in an existing card.

Flowchart. A graphic description or diagram of the flow of data within a program.

BAL (Basic Assembler Language). An automatic coding system designed to simplify programming of problems on the S/360.

Symbolic Language. A language that is based on machine language but allows the usage of mnemonics, symbolics and special routines to aid in programming.

Systems Design. A detailed outline and description of procedures to follow in performing a prescribed record keeping task.

Software. Software is the programming system used by a data processing operation (in addition to the computer) which includes assembler, compiler, and utility programs.

VI. PROCEDURES

The procedures to be followed to meet the objectives of the proposed study are:

1. an extensive review of related literature will be conducted.

2. a survey will be made of the four-year degree programs in the state to determine what is available in data processing courses and a catalog description of each of the courses will be put in the Appendix of the study.

3. a committee will be established to have input into the development of the curriculum - among the members will be the Director of the Computer Center at Appalachian State University who is also an Associate Professor of Business Administration in the College of Business and who has an extensive background not only in administration but also in teaching data processing courses, Dean of the College of Business, members of the Computer Policy and Advisory Council, and two faculty members from community colleges who are presently teaching data processing courses in their institutions. It should be noted that the author of the proposed study has and is presently working in a data processing environment and has taught data processing courses on the graduate and undergraduate levels in senior institutions and also in the community college.

VII. EXPECTATIONS

The curriculum to be developed will be presented to the Dean of the College of Business who is planning to present it to the appropriate committees and persons responsible for the implementation of new major programs. The fact that the University sees a need for such a curriculum, has given permission and approval for conducting the study, and plans to take and use the results indicates a positive and immediate change within the institution if the study is approved by NOVA University.

VIII. ORGANIZATION OF THE STUDY

Chapter I will include the general background of the study, statement of the problem, importance of the study, limitations of the study, definitions of terms, procedures, expectations, and organization of the study.

A review of related literature will be presented in Chapter II.

Chapter III will include the curriculum and discussion of the courses.

Summary and conclusions will be presented in Chapter IV.

LIST OF REFERENCES

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Hertz, D. B. Shortage of computer personnel seen at famine stage by 1970. The National Underwriter, 1966, 4, 61

Raach, F. R. More training programs needed at all levels to avert personnel shortage. Computers and Automation, 1966, 15, 12.

Wood, M. W., and Espegren, R. G. What is data processing all about? Business Education World, 1964, 45.

For Office Use Only

Practicum Director's Approval ___yes ___no

Date Approval Was Mailed _____

For Office Use Only

Cluster _____

Multiple Practicum ___yes ___no

Date Received _____

PRACTICUM PROPOSAL CHECK SHEET*

1. Name of participant(s): Emily D. Gloster

Cluster: Loone, North Carolina Date: May 31, 1974

2. Job title: Director, School Support Services Division, College of Continuing Education and Instructor, College of Business, Appalachian State University

3. Area of specialization (circle one)

X a) Administration

b) Behavioral Sciences

c) Engineering Technology

d) Curriculum and Instruction

4. Title of the practicum: A CURRICULUM STUDY IN DATA PROCESSING

5. What change in your institution are you proposing? Providing a curriculum to be used by the College of Business to use as input into the development of a data processing curriculum

6. Where will the practicum be carried out?

Institution: Appalachian State University

Department: College of Business

7. Does the design contain criteria for measuring the results of the practicum? Yes

8. What are the required inputs?

a) Estimated number of man-hours to do the practicum, and by whom?

300 hours by author

b) Are needed facilities and other means available?

Yes

Note: If the performance of the practicum requires prior approval from a superior, has such approval been secured?

Yes

refer to page 2

c) Time span -- when (date) will the practicum be started and when (date) is it expected to end?

Started as soon as given approval and will end July 18, 1974

d) In case of a joint practicum, has the role of each practitioner been clearly and fully described?

N/A

9. Nova University target date for submitting proposal

May 31, 1974

10. Nova University target date for completed practicum

July 18, 1974

* As an aid to the participant in drawing up a practicum proposal (and for evaluation), this check sheet should be filled out and submitted with the proposal.